(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 October 2002 (24.10.2002)

PCT

(10) International Publication Number
WO 02/083455 A2

(51) International Patent Classification[7]: B60P

(21) International Application Number: PCT/US02/12209

(22) International Filing Date: 17 April 2002 (17.04.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/284,543 17 April 2001 (17.04.2001) US

(71) Applicant *(for all designated States except US)*: **LIFT-U, DIVISION OF HOGAN MGF., INC.** [US/US]; 1520 First Street, Escalon, CA 95320 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **COHN, Alan** [US/US]; 17256 North Tretheway Road, Lockeford, CA 95237 (US).

(74) Agent: **DENKENBERGER, John, D.**; Christensen O'Connor Johnson & Kindness PLLC, Suite 2800, 1420 Fifth Avenue, Seattle, WA 98101 (US).

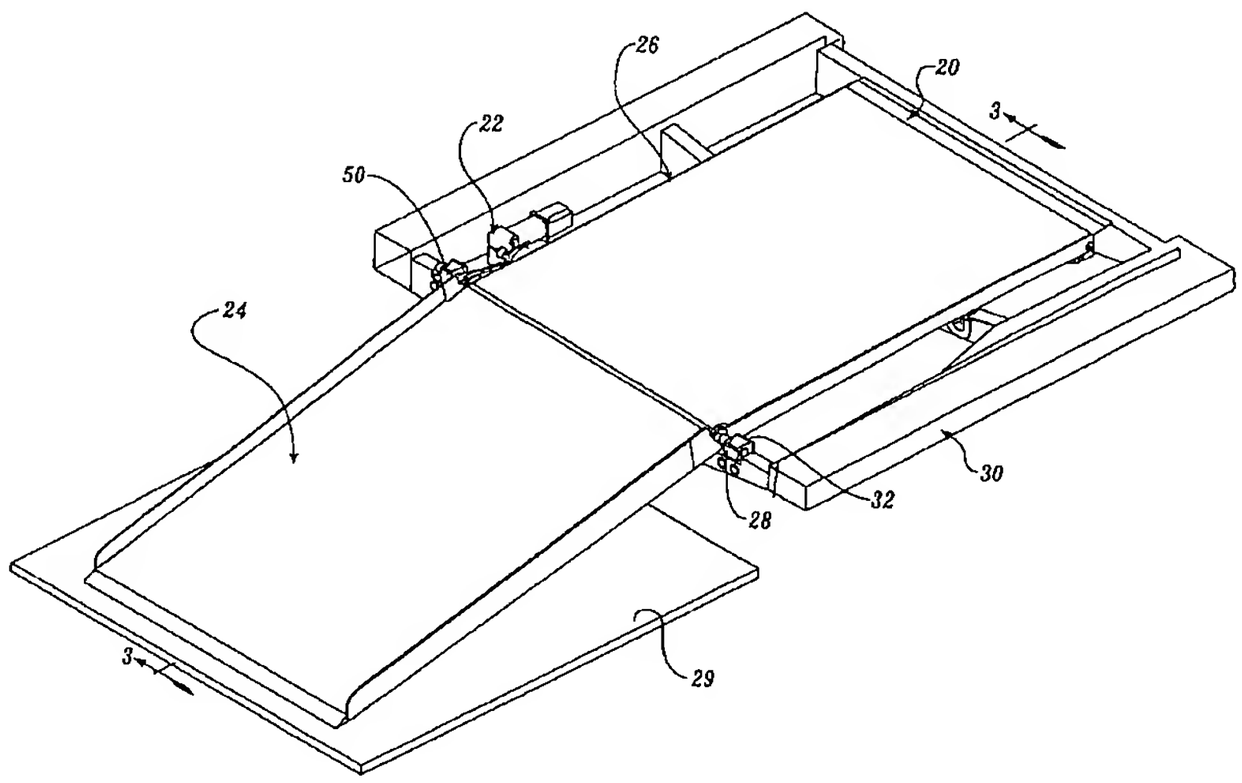
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: VEHICLE FOLD-OUT RAMP



(57) Abstract: A ramp assembly (20) having a frame attachable to a vehicle having a floor is disclosed. The ramp assembly further includes a platform coupled to a portion of the frame, a ramp having a weight, and a reciprocating mechanism disposed between the ramp and the platform coupled to a portion of the frame. The ramp assembly also includes a reciprocating mechanism disposed between the ramp and the platform for reciprocating the ramp between a deployed position and a stowed position in response to a load. The reciprocating mechanism counterbalancing the weight of the ramp during actuation of the ramp between the deployed and stowed positions to reduce the load required to reciprocate the ramp between the deployed and stowed positions.

WO 02/083455 A2

VEHICLE FOLD-OUT RAMP

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Patent Application No. 60/284,543, filed April 17, 2000, the disclosure of which is hereby expressly incorporated by reference, and the benefit of the filing date of which is hereby claimed under 35 U.S.C. § 119(e).

FIELD OF THE INVENTION

The present invention relates generally to wheelchair lifts and, more particularly, to a fold-out ramp for a vehicle.

BACKGROUND OF THE INVENTION

The Americans with Disabilities Act (ADA) requires the removal of physical obstacles to those who are physically challenged. The stated objective of this legislation has increased public awareness and concern over the requirements of the physically challenged. Consequentially, there has been more emphasis in providing systems that assist such a person to access a motor vehicle, such as a bus or minivan.

A common manner of providing the physically challenged with access to motor vehicles is a ramp. Various ramp operating systems for motor vehicles are known in the art. Some slide out from underneath the floor of the vehicle and tilt down. Others are stowed in a vertical position and are pivoted about a hinge, while still others are supported by booms and cable assemblies. The present invention is generally directed to a "fold-out" type of ramp. Such a ramp is normally stowed in a horizontal position within a recess in the vehicle floor, and is pivoted upward and outward to a downward-sloping extended position. In the extended position, the ramp is adjustable to varying curb heights.

Fold-out ramps on vehicles confront a variety of technical problems. Longer ramps are desirable because the resulting slope is lower and more accessible by wheelchair-bound passengers. Longer ramps are, however, heavier and require more torque about the hinge to be reciprocated between deployed and stowed positions. To satisfy this torque requirement, such fold-out ramps use large electric motors, pneumatic devices, or hydraulic actuators to deploy and stow the ramp. Many of such systems cannot be moved manually in the event of failure of the power source unless the drive mechanism is first disengaged. Some existing fold-out ramps can be deployed or stowed

manually, but they are difficult to operate because one must first overcome the resistance of the drive mechanism. Moreover, some fold-out ramps create a dangerous situation in the event of a power failure because they could deploy and crush objects in the downward path.

As noted above, many existing fold-out ramps are equipped with hydraulic, electric, or pneumatic actuating devices. Such devices are obtrusive and make access to and from a vehicle difficult when the ramp is stowed. Moreover, many of such fold-out ramps have no energy storage capabilities to aid the lifting of the ramp, and thereby preserve the life of the drive motor or even allow a smaller drive to be employed. Finally, operating systems for such fold-out ramps must have large power sources to overcome the torque placed on the hinge by the necessarily long moment arm of the fold-out ramp.

In view of the foregoing, there is a need for a compact and efficient operating system for a vehicle fold-out ramp.

SUMMARY OF THE INVENTION

In accordance with the present invention, a wheelchair ramp assembly is provided. The wheelchair ramp assembly includes a frame attachable to a vehicle having a floor, a platform coupled to a portion of the frame, a ramp having a weight, and a reciprocating mechanism disposed between the ramp and platform. The reciprocating mechanism reciprocates the ramp between a deployed position and a stowed position in response to a force. The reciprocating mechanism counterbalances the weight of the ramp during actuation of the ramp between the deployed and stowed positions to reduce the force required to reciprocate the ramp between the deployed and stowed positions.

In accordance with certain aspects of this embodiment, the reciprocating mechanism includes a torsion assembly having a torsion rod extending between a rotating end and a fixed end of the reciprocating mechanism. As the ramp is reciprocated between the deployed and stowed positions, the weight of the ramp causes the torsion rod to twist about the fixed end and resist the weight of the ramp.

In accordance with still other aspects, the reciprocating mechanism includes an actuating arm rotatably attached to the torsion assembly and first and second bearing surfaces cooperatively coupled to the ramp, wherein the first and second bearing surfaces move in a predetermined path as the ramp reciprocates between the deployed and stowed positions to contact a portion of the actuating arm and cause the torsion rod to twist.

In accordance with still yet other aspects, the wheelchair assembly includes a preload assembly coupled to the torsion assembly, wherein the preload assembly twists the torsion rod from a neutral position to assist in reciprocating the ramp between the deployed and stowed positions.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and many of the attendant advantages of this invention will become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a perspective view of a fold-out ramp constructed in accordance with one embodiment of the present invention, with the fold-out ramp shown in the stowed position;

FIGURE 2 is a perspective view of a fold-out ramp formed in accordance with one embodiment of the present invention, with the fold-out ramp shown in the deployed position;

FIGURE 3 is a cross-sectional perspective view of a fold-out ramp formed in accordance with one embodiment of the present invention, with the fold-out ramp shown in the deployed position;

FIGURE 4 is a cross-sectional planar view of a counterbalance assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 5 is a perspective view of a fold-out ramp formed in accordance with one embodiment of the present invention, showing a fixed attachment point of the fold-out ramp to a mounting structure;

FIGURE 6 is a perspective view of a fold-out ramp formed in accordance with one embodiment of the present invention, showing a rotating attachment point of the fold-out ramp to a mounting structure;

FIGURE 7 is a perspective cross-sectional view of a fixed attachment end of a counterbalance assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 8 is a perspective cross-sectional view of a rotating attachment end of a counterbalance assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 9 is a perspective view of a ramp, drive motor assembly, and pivot link assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention with structure removed for clarity;

FIGURE 10 is a perspective view of a pivot link assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 11 is a cross-sectional perspective view of a pivot link assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention and showing one end of the pivot link assembly;

FIGURE 12 is a cross-sectional side planar view of a fold-out ramp, formed in accordance with one embodiment of the present invention, showing the fold-out ramp in a partially deployed position;

FIGURE 13 is a cross-sectional side planar view of a fold-out ramp, formed in accordance with one embodiment of the present invention, showing the fold-out ramp in a substantially neutral position;

FIGURE 14 is a cross-sectional side planar view of a fold-out ramp, formed in accordance with one embodiment of the present invention and showing the fold-out ramp in the fully deployed position;

FIGURE 15 is a perspective view of a fold-out ramp, formed in accordance with the present invention and showing a first alternate embodiment of the counterbalance assembly;

FIGURE 16 is a partial perspective view of a fold-out ramp, formed in accordance with the present invention and showing a more detailed view of the motor drive assembly and linkage assembly of the counterbalance assembly of FIGURE 15;

FIGURE 17 is an exploded view of the fold-out ramp assembly of FIGURE 15, showing the major components of the fold-out ramp assembly;

FIGURE 18 is a perspective view of a torsion pin weldment for the counterbalance assembly;

FIGURE 19 is a top planar view of the torsion pin weldment of FIGURE 18;

FIGURE 20 is a side planar view of the torsion pin weldment of FIGURE 19, taken through Section 20-20;

FIGURE 21 is an end planar view of the torsion pin weldment of FIGURE 18;

FIGURE 22 is a perspective view of the first alternate embodiment of the counterbalance assembly for the ramp assembly of FIGURE 15, with portions of the ramp removed for clarity;

FIGURE 23 is a perspective view of the counterbalance assembly of FIGURE 22, wherein the counterbalance assembly is rotated 180° from the view shown in FIGURE 22;

FIGURE 24 is a side planar view of the counterbalance assembly of FIGURE 22;

FIGURE 25 is a top planar view of the counterbalance assembly of FIGURE 24;

FIGURE 26 is a partial cross-sectional side planar view of the counterbalance assembly of FIGURE 24, taken through Section 26-26;

FIGURE 27 is a cross-sectional side planar view of the counterbalance assembly of FIGURE 24, taken through Section 27-27;

FIGURE 28 is a top planar view of the fold-out ramp assembly, showing the fold-out ramp assembly in the fully deployed position;

FIGURE 29 is a partial cross-sectional side planar view of the fold-out ramp of FIGURE 28, showing the counterbalance assembly and taken through Section 29-29 of FIGURE 28;

FIGURE 30 is a perspective view of a fold-out ramp of FIGURE 15, with the fold-out ramp shown in the stowed position;

FIGURE 31 is a top planar view of the fold-out ramp of FIGURE 30;

FIGURE 32 is a partial cross-sectional side planar view of the fold-out ramp of FIGURE 31, taken through Section 32-32;

FIGURE 33 is a perspective view of the fold-out ramp of FIGURE 15, with the fold-out ramp shown in a substantially 90° deployment position.

FIGURE 34 is a top planar view of the fold-out ramp assembly of FIGURE 33;

FIGURE 35 is a partial cross-sectional side planar view of the fold-out ramp assembly of FIGURE 34, taken through Section 35-35;

FIGURE 36 is a perspective view of a second alternate embodiment of a counterbalance assembly for a fold-out ramp, formed in accordance with the present invention, with portions of the fold-out ramp assembly removed for clarity;

FIGURE 37 is an end planar view of the counterbalance assembly of FIGURE 36;

FIGURE 38 is a side planar view of the counterbalance assembly of FIGURE 37 and taken through Section 38-38;

FIGURE 39 is a partial cross-sectional end planar view of the counterbalance assembly of FIGURE 38 and taken through Section 39-39;

FIGURE 40 is a cross-sectional side planar view of the counterbalance assembly of FIGURE 37 and taken through Section 40-40;

FIGURE 41 is a cross-sectional side planar view of the counterbalance assembly of FIGURE 37 and taken through Section 41-41;

FIGURE 42 is a perspective view of the counterbalance assembly of FIGURE 36, where the counterbalance assembly is rotated 180° from the view shown in FIGURE 36;

FIGURE 43 is a partial view of the counterbalance assembly of FIGURE 42, with portions thereof removed for clarity;

FIGURE 44 is a perspective view of a fold-out ramp assembly, formed in accordance with the second alternate of the counterbalance assembly of FIGURE 36;

FIGURE 45 is a partial view of the fold-out ramp assembly of FIGURE 44, showing the counterbalance assembly of FIGURE 36;

FIGURE 46 is a perspective view of a rear stub shaft of a ramp assembly of the present invention, with the second alternate counterbalance assembly of FIGURE 36;

FIGURE 47 is a perspective view of a fold-out ramp, formed in accordance with one embodiment of the present invention, showing the fold-out ramp in the closed position;

FIGURE 48 is a perspective view of a counterbalance assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 49 is a perspective view of a fold-out ramp, formed in accordance with one embodiment of the present invention and showing a stub shaft;

FIGURE 50 is a perspective view of a fold-out ramp, formed in accordance with one embodiment of the present invention and showing an adjustment assembly to selectively preload the counterbalance assembly;

FIGURE 51 is a perspective view of a drive assembly for a fold-out ramp, formed in accordance with the present invention;

FIGURE 52 is a perspective view of an idler and roller assembly for a drive assembly of a fold-out ramp, formed in accordance with one embodiment of the present invention and showing a chain tension assembly;

FIGURE 53 is a perspective view of an attachment arm for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 54 is a perspective view of a cam and roller assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 55 is a perspective view of a portion of the cam and roller assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention and showing one embodiment of a stow latch assembly in a locked position;

FIGURE 56 is a perspective view of a portion of the cam and roller assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention and showing one embodiment of a stow latch assembly in an unlocked position;

FIGURE 57 is a perspective view of a clutch assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 58 is an exploded view of a clutch assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 59 is a cross-sectional perspective view of a clutch assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 60 is a partial perspective view of a handle assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention and showing the handle assembly in a down position;

FIGURE 61 is a partial perspective view of a handle assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention and showing the handle assembly in an up position;

FIGURE 62 is a partial perspective cutaway view of a handle assembly and stow latch assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 63 is a partial side view of a handle assembly and stow latch assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 64 is a partial cross-sectional perspective view of a stow latch assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 65 is a partial perspective view of a handle assembly and stow latch assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention and showing the handle assembly in an up position;

FIGURE 66 is a side planar view showing a handle assembly and stow latch assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention and showing the handle assembly in an up position;

FIGURE 67 is a partial cross-sectional view of a handle assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention;

FIGURE 68 is a partial cross-sectional view of a handle assembly for a fold-out ramp, formed in accordance with one embodiment of the present invention and showing the handle assembly in an up position;

FIGURE 69 is a perspective view of a fold-out ramp assembly, formed in accordance with one embodiment of the present invention, showing the fold-out ramp in a stowed position;

FIGURE 70 is a partial perspective view of a fold-out ramp assembly, formed in accordance with one embodiment of the present invention, showing an adjustment assembly for selectively preloading the counterbalance assembly, wherein the adjustment assembly is shown in a loaded condition;

FIGURE 71 is a partial side planar view of the fold-out ramp assembly and adjustment assembly depicted in FIGURE 70, wherein the adjustment assembly is shown in the loaded condition;

FIGURE 72 is a partial side planar view of the fold-out ramp assembly and adjustment assembly depicted in FIGURE 70, wherein the adjustment assembly is shown in the unloaded condition;

FIGURE 73 is a partial perspective view of the fold-out ramp assembly depicted in FIGURE 69, showing the adjustment assembly in the loaded condition;

FIGURE 74 is a partial perspective view of the fold-out ramp assembly and adjustment assembly depicted in FIGURE 73, wherein a bearing block has been removed to show the coupling of a torsion lever arm to a torsion bar;

FIGURE 75 is a perspective view of a torsion lever arm assembly, formed in accordance with the present invention and suitable for use with the fold-out ramp assembly depicted in FIGURE 69;

FIGURE 76 is an exploded perspective view of the torsion lever arm assembly depicted in FIGURE 75, wherein the bearing block has been separated from the torsion lever arm assembly to show the torsion lever arm;

FIGURE 77 is a reverse perspective view of the torsion lever arm assembly depicted in FIGURE 76, wherein the bearing block has been separated from the torsion lever arm assembly to show à pair of saddle bearings attached to the bearing block;

FIGURE 78 is a perspective view of a torsion bar, formed in accordance with the present invention and suitable for use with the fold-out ramp assembly depicted in FIGURE 69;

FIGURE 79 is a partial perspective view of the torsion bar illustrated in FIGURE 78, showing a lobed spline end for engaging the torsion lever arm;

FIGURE 80 is a perspective view of the fold-out ramp assembly depicted in FIGURE 69, wherein the fold-out ramp has been rotated 90 degrees counterclockwise from the position depicted in FIGURE 69;

FIGURE 81 is a partial perspective view of the fold-out ramp assembly depicted in FIGURE 80, showing a counterbalance linkage assembly in a loaded condition;

FIGURE 82 is a partial side planar view of the counterbalance linkage assembly depicted in FIGURE 81, showing the counterbalance linkage assembly in the loaded condition;

FIGURE 83 is a partial side planar view of the counterbalance linkage assembly depicted in FIGURE 81, showing the counterbalance linkage assembly in an unloaded condition;

FIGURE 84 is a perspective view of the fold-out ramp assembly, partially deployed in a vertical position, wherein a rising floor has been removed for clarity;

FIGURE 85 is a partial perspective view of the fold-out ramp assembly depicted in FIGURE 84, showing the counterbalance linkage assembly in the loaded condition and with a pin joining a torsion lever arm to a counterbalance actuating arm;

FIGURE 86 is a partial perspective view of the fold-out ramp assembly depicted in FIGURE 84, wherein the counterbalance linkage assembly is shown in the unloaded condition and with the counterbalance actuating arm shown in the engaged position;

FIGURE 87 is a partial perspective view of the fold-out ramp assembly depicted in FIGURE 84, wherein the counterbalance linkage assembly is shown in the unloaded condition and with the counterbalance actuating arm shown in the disengaged position;

FIGURE 88 is a reversed partial perspective view of the fold-out ramp assembly depicted in FIGURE 87, showing the counterbalance linkage assembly in the unloaded condition and with the counterbalance actuating arm shown in the disengaged position; and

FIGURE 89 is a partial perspective view of the fold-out ramp assembly depicted in FIGURE 88, wherein the counterbalance linkage assembly is shown in the unloaded

condition and with the counterbalance actuating arm shown in the disengaged position, wherein the frame side rail has been removed for clarity.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGURES 1 and 2 illustrate one embodiment of a fold-out ramp assembly 20 (hereinafter "ramp assembly 20") constructed in accordance with the present invention. The ramp assembly 20 includes a drive assembly 22, a ramp 24, a moving floor 26, and a counterbalance assembly 28. The ramp assembly 20 is adapted to be mounted to frame structure 30 of a vehicle (not shown), such as a bus, by mounting bracket 32. The ramp assembly 20 is reciprocal between a stowed position, as seen in FIGURE 1, and a deployed position, as seen in FIGURE 2. In the stowed position, the ramp 24 and moving floor 26 are stacked upon each other in a bi-fold manner, such that the lower surface of the ramp 24 is flush with the floor (not shown) of the vehicle. In the deployed position, the ramp extends outward and contacts a surface 29, such as a curb or road side.

As seen best by referring to FIGURE 3, the ramp 24 is hingedly attached to the moving floor 26 by the counterbalance assembly 28. The ramp 24 includes side curbs 34. The side curbs 34 extend upwardly from each side of the ramp 24. Each side curb 34 enhances structural strength of the ramp 24 and provides a bumper for the sides of the ramp 24, thereby increasing the safety of the ramp assembly 20. The ramp 24 is constructed from well-known materials, such as stainless steel, and, in one embodiment, includes upper and lower panels 36a and 36b spaced by a core 38. The core 38 is suitably corrugated stainless steel extending between opposing sides of the upper and lower panels 36a and 36b. The outboard edge of the ramp 24 includes a tapered nose portion 40. The ramp 24 is wedged shape in cross-section from the nose portion 40 to the inboard portion, which is attached to the counterbalance assembly 28.

The moving floor assembly 26 is similarly constructed to the ramp 24 and includes an upper panel 42 and a corrugated panel 44 welded to the upper panel 42 to increase stiffness and reduce weight of the structure. The inboard edge of the moving floor 26 is attached to the frame structure 30 by a pivot link assembly 46. The other end of the moving floor 26 is pivotally attached to the side curb 34, as is described in greater detail below. When mounted to the vehicle frame structure 30, the vehicle floor (not shown) is substantially flush and is in close proximity with the upper panel 42 of the moving floor 26 when the ramp 24 is in the deployed position to provide smooth transition between the moving floor 26 and the vehicle floor.

As noted above, when the ramp assembly 20 is in the stowed position, the lower panel 36b of the ramp 24 is substantially co-planar with the floor (not shown) of the vehicle, thereby providing a smooth transition between the floor of the vehicle and the ramp assembly 20. Because of the wedge contour of the ramp 24 and corresponding shape of the moving floor 26, when articulated into the stowed position, the ramp 24 is nested with the moving floor 26. In particular, the upper panel 36a of the ramp 24 is adjacent the upper panel 42 of the moving floor 26, such that the floor surface (which is the lower panel 36b of the ramp 24) of the ramp 24 is flush with the vehicle floor.

Referring now to FIGURES 4-8, the counterbalance assembly 28 will be described in greater detail. The counterbalance assembly 28 includes a fixed end 48 and a rotating end 50. The fixed end 48 includes a bearing block 52, a key insert 54, and a torsion tube shaft 58. The moving floor 26 is pinned to the ramp 24 at the boss and pin structure 56. As seen best in FIGURE 5, the moving floor 26 includes a lug 60 extending from one end and the lug 60 is pinned to the side curb 34 by a boss and pin structure 56. Movement of the ramp 24 is tied to the moving floor 26, such that the moving floor 26 moves with corresponding movement of the ramp 24 between stowed and deployed positions, as is described in greater detail below. Received within the key insert 54 is one end of a torsion rod 62, thereby locking the fixed end 48 of the counterbalance assembly 28 to the bearing block 52 to resist rotation of the torsion rod 62, as is described in greater detail below.

Referring now to FIGURE 6, the rotating end 50 of the counterbalance assembly 28 will now be described in greater detail. The rotating end 50 includes a key insert 64, a bearing block 66, and a boss and pin structure 68. The rotating end 50 is similar to the fixed end 48 described above, with the exception that the key insert 64 of the rotating end 50 is attached to a torsion tube shaft 70, which, in turn, is attached to the ramp 24 and rotates with the ramp 24, as is described in greater detail below.

Still referring to FIGURES 4-8, the counterbalance assembly 28 includes a torsion tube 72 extending between the fixed and rotating ends 48 and 50. The rotating end 50 also includes a sprocket 74 fixed to the torsion tube shaft 70, such that when the drive assembly 22 is attached to the sprocket 74, the torsion rod 62 is twisted within the counterbalance assembly 28.

In operation, one end of the torsion rod 62 is fixed to the torsion tube shaft 70 by the key insert 64, such that as the drive assembly 22 causes the ramp 24 to rotate, the

rotating end 50 of the torsion rod 62 twists to counterbalance the weight of the ramp 24. This reduces the load to drive the ramp 24 between stowed and deployed positions, thereby reducing motor drive requirements as well as improved weight and cost savings. Also, the counterbalance assembly 28 reduces the force required to manually operate the ramp 24 between stowed and deployed positions. The counterbalance assembly 28 preloads the ramp 24 in the stowed or deployed positions and is maintained in any position between the deployed and stowed positions by the combined resistance of the drive assembly 22, including the gear motor and/or system friction. The neutral position for the counterbalance assembly 28 is when the ramp 24 is nearly vertical, such that in either the stowed or deployed positions, the counterbalance assembly 28 is loaded because the torsion rod 62 is twisted from its normal shape or condition. This results in reduced load and forces required to reciprocate the ramp 24 between its stowed and deployed positions.

Referring now to FIGURES 9-11, the pivot link assembly 46 will be described in greater detail. The pivot link assembly 46 includes a bracket 76, a pivot rod 78, a spacer 80, and first and second links 82a and 82b. The bracket 76 is adapted to be fastened to frame structure 30 by well-known fasteners, such as bolts and screws. The pivot rod 78 is attached by a well-known fastener, such as a weld, to one end of the first and second pivot links 82a and 82b. The other ends of the first and second pivot links 82a and 82b are pivotably attached opposite ends of the spacer 80. The inboard end of the moving floor 26 is pivotally attached to the pivot rod 78 by a well known fastener 90, such as a pin or shoulder screw, extending through a side plate 92 of the moving floor 26 and into the pivot rod 78.

Operation of the moving floor 26 may be best understood by referring to FIGURES 12-14. As the ramp 24 begins its actuation sequence from the stowed to the deployed position, the ramp 24 pivots about the counterbalance assembly 28. The moving floor 26 pivots about the spacer 80, and it also translates slightly outboard from its stowed position. Because the moving floor 26 is attached to the pivot link assembly 46 by the links 82a and 82b and attached to side curb 34 at boss 56, the moving floor acts as a coupler of a four bar linkage. Further, as the ramp 24 continues to the deployed position, the moving floor is raised upwardly to a position substantially flush with the floor of the vehicle by the pivot link assembly 46. Thus, as the ramp

assembly 20 reciprocates between its deployed and stowed position, the moving floor 26 both rotates and translates into and out of flush position with the floor of the vehicle.

Referring now to FIGURES 15-30, a first alternate embodiment of a fold-out ramp 1020, formed in accordance with the present invention, will now be described in greater detail. The fold-out ramp assembly 1020 is identical in materials and operation as the embodiment described above, with the exception that a new counterbalance assembly 1028 is included. As may be best seen by referring to FIGURE 17, this embodiment of the fold-out ramp assembly 1020 includes three bearing points 1092a, 1092b, and 1092c. The counterbalance assembly 1028 includes a torsion pin weldment assembly 1094, a counterbalance linkage assembly 1096, an adjustment assembly 1098, and a torsion bar 1100.

The torsion pin weldment assembly 1094 may be best understood by referring to FIGURES 18-21. The torsion pin weldment assembly 1094 includes first and second support brackets 1110a and 1110b, first and second cam pins 1112a and 1112b, and first and second stub shafts 1114a and 1114b. The first and second cam pins 1112a and 1112b extend laterally between the first and second support brackets 1110a and 1110b. The second stub shaft 1114b may be integrally formed with and extends laterally from the second support bracket 1110b. The first stub shaft 1114a includes a hex-shaped cavity 1115 extending partially therethrough and is sized to receive a correspondingly-shaped hex stub 1116b (FIGURE 17) extending laterally from the ramp 1024. As a result, the ramp 1024 is keyed to the rotation of the torsion pin weldment assembly 1094.

Referring now to FIGURES 22-26, the counterbalance linkage assembly 1096 will now be described in greater detail. The counterbalance linkage assembly 1096 includes an arm 1120, a torsion arm 1122, a motor mount plate 1124, and a support plate 1126. The first and second stub shafts 1114a and 1114b of the torsion pin weldment assembly 1094 described above extend between opposed surfaces of the motor mount plate 1124 and a portion of the support plate 1126, which also includes bearings 1092b and 1092c sized to receive corresponding stub shafts 1114a and 1114b. The cam pins 1112a and 1112b of the torsion pin weldment assembly 1094 are positioned to engage a portion of the arm 1120, as described in greater detail below.

The torsion arm 1122 includes a clevis 1128 extending upwardly from the base of the torsion arm 1122. The clevis 1128 is sized to receive one end of the arm 1120 therebetween. The arm 1120 is rotatably attached within the clevis 1128 by a pin 1130

extending laterally through the clevis 1128 and the corresponding end of the arm 1120. The free end of the arm 1120 is cammed to included first and second saddles 1132a and 1132b.

As best seen by referring to FIGURE 26, the first and second saddles 1132a and 1132b are sized to selectively receive the first and second cam pins 1112a and 1112b during actuation of the ramp platform 1024. The cam pins 1112a and 1112b are orientated such that when the ramp is rotated through its range of motion, each cam pin separately engages one of the two saddles 1132a and 1132b. One cam pin functions from the stowed ramp position to the vertical position. The other cam pin functions from the vertical position to the fully deployed ramp position. Typically, only one pin at a time correspondingly engages one of the two saddles 1132a and 1132b, thereby causing the torsion arm 1122 to rotate, and thus load the torsion rod 1100. The cam pins may simultaneously engage the saddles 1132a and 1132b when the ramp angle is nearly vertical, as seen in FIGURE 26.

As may be best seen by referring back to FIGURE 22, one end of the torsion bar 1100 is supported by the motor mount support plate 1124 and support plate 1126, and is keyed to the torsion arm 1122. The other end of the torsion bar 1100 is supported by a support block 1134 and is keyed to a tapered lever 1138 of an adjusting assembly 1098. The adjusting assembly 1098 allows preload or deadband adjustment of the counterbalance assembly 1028.

As best seen by referring to FIGURE 27, the adjustment assembly 1098 includes a set screw 1136 and the tapered lever 1138. One end of the tapered lever 1138 is keyed to the torsion bar 1100 and is adapted to limit rotation of one end of the torsion bar 1100. The other end of the tapered lever 1138 is seated against the lower end of the set screw 1136. Adjustment of the set screw 1136 controls the preload or deadband stiffness of the torsion bar 1100.

Also seen in FIGURE 27 is first bearing 1092a, which is sized and adapted to receive a corresponding stub shaft 1116a (FIGURE 17) extending laterally from one end of the ramp 1024.

The ramp assembly 1020 in the fully deployed position may be best understood by referring to FIGURES 28-29. As seen in FIGURE 29, only one of the two cam pins (1112b) of the torsion pin weldment assembly 1094 is seated within the saddle 1132b of the arm 1120.

The ramp assembly 1020 in the fully stowed position may be best understood by referring to FIGURES 30-32. In the fully stowed position, and as may be best seen by referring to FIGURE 32, cam pin 1112a is seated in the first saddle 1132a of arm 1120.

The ramp assembly 1020 in the near vertical position may be best understood by referring to FIGURES 33-35. As may be best seen by referring to FIGURE 35, in the near vertical 90° position, both cam pins 1112a and 1112b are seated within the first and second saddles 1132a and 1132b of the arm 1120.

Referring now to FIGURES 36-46, another embodiment of a fold-out ramp 2020 of the current invention will now be described in greater detail. This embodiment is identical in materials and operation to the invention described above, with the exception that a counterbalance assembly 2028 constructed in accordance with this embodiment of fold-out ramp assembly 2020 includes only two bearing points 2092a and 2092b instead of three bearing points.

As may be best seen by referring to FIGURES 42-46, the counterbalance linkage assembly 2096 includes an arm 2120 and a torsion arm 2122. In this embodiment, the rear stub shaft 2140 of the ramp assembly 2024 replaces the hex stub shaft 1116b of the first alternate embodiment. The rear shaft 2140 includes a spherical surface 2142 located on one end of the rear stub shaft 2140. The outer face of the rear stub shaft 2140 includes a pair of cavities 2144a and 2144b. Each cavity 2144a and 2144b is sized to receive a corresponding cam pin 2112a and 2112b. As an alternative, each cam pin may be integral with the rear stub shaft 2140.

Each cam pin 2112a and 2112b is fixed to rear stub shaft 2140 by welding or other means. Each cam pin 2112a and 2112b supports a bearing 2512. The bearings 2512a and 2512b engage saddles 2132a and 2132b of arm 2120. Torque rod 2100 is keyed to torque arm 2122 at one end and is keyed to tapered lever 2138 at the other end. Support block 2134 supports tapered lever 2138 on surface 2138a. Motor mount plate 2124 supports bearing block 2124a. Bearing 2124b is housed in bearing block 2124a (FIGURE 39). Torsion arm 2122 is pivotally supported by bearing 2124b at surface 2122a. Thus, torsion arm 2122 is pivotally attached to motor mount plate 2124.

The counterbalance assembly 2028 includes a second stub shaft 2148 extending from the first bearing member 2192a. The rear stub shaft 2140 and stub shaft 2148, located in ramp platform 2024, are sized to be received within corresponding

bearings 2092b and 2092a. Operation is the same as first alternate embodiment. Corresponding numbers start with 2xxx in place of 1xxx.

Referring now to FIGURES 47-68, a third alternate embodiment of the current invention will now be described in greater detail. Like the second alternate embodiment, the third alternate embodiment has two bearing points 3092a and 3092b. The fold-out ramp 3020, formed in accordance with the third embodiment of the present invention, is similar in materials and operation to the alternate embodiments described above with the following exceptions. First, elements of the counterbalance linkage assembly 3022 have been repositioned or redesigned. Second, a new drive assembly 3024 (FIGURE 52) has been provided. The moving floor 26 and 1026 of the previous embodiments has been replaced with a rising floor 3026. A clutch assembly 3028 has been added. A unitized frame 3999 has been added. Finally, a stow latch assembly 3030 has been added. For conciseness, only the foregoing exceptions will be described in greater detail.

Referring to FIGURES 47-50, the counterbalance linkage assembly 3022 will now be described in greater detail. The counterbalance linkage assembly 3022 includes a torsion bar 3034, a torsion arm 3036, an actuating arm 3038, and an adjustment assembly 3039. The torsion bar 3034 is similar in operation and materials to the torsion bar 1100 (FIGURE 22) described in the previous embodiments, except that it has been moved from the outboard side (curb side) of the fold-out ramp assembly 3020 to the inboard side (road side). Specifically, the location of the torsion bar 3034 has been moved from the side of the ramp nearest the curb to a location towards the longitudinally extending centerline of the vehicle.

The actuating arm 3038 is similar in operation and materials to the actuating arm 1120 (FIGURES 22-26) described in the previous embodiments, except that it has been lengthened. As set forth above for the arm 1120, the actuating arm 3038 is suitably rotatably attached to torsion arm 3036 by a pin 3039 extending laterally through the corresponding end of the actuating arm 3038. The free end of the actuating arm 3038 is cammed to include first and second saddles 3040a and 3040b.

The torsion arm 3036 has been moved with the repositioned torsion bar 3034. The torsion arm 3036 is similar to materials and operation to the torsion arm 1122 (FIGURES 22-26) of the first embodiment and the torsion arm 2122 (FIGURES 42-46) of the second alternate embodiment. As best seen in FIGURE 48, the linkage and operation of the torsion arm 3036 and the actuating arm 3038 have not changed in this

third alternate embodiment. The torsion arm 3036 extends between the torsion bar 3034 and the actuating arm 3038. One end of the torsion arm 3036 is pinned to a corresponding end of the actuating arm 3038 by a well-known pin 3039. The other end of the torsion arm 3036 is keyed to an end of the torsion bar 3034.

As best seen in FIGURE 49, the free end of the actuating arm 3038 has first and second saddles 3040a and 3040b. First and second bearings 3042a and 3042b are positioned on the end of first stub shaft 3046a and engage saddles 3040a and 3040b in the same general way as described in the previous embodiments. Similar to the previous embodiments described above, rotation of first stub shaft 3046a is keyed to the rotation of the ramp platform 3044, such that when the ramp is rotated through its range of motion, the bearings 3042a and 3042b engage the first and second saddles 3040a and 3040b, stroking the actuating arm 3038 and thereby causing the torsion arm 3036 to rotate and place a load upon the torsion bar 3034. As the end of the torsion bar 3034 is rotated by the torsion arm 3036, the torsion bar 3034 twists to counterbalance the weight of the ramp.

Referring now to FIGURE 50, the adjustment assembly 3039 will now be described in greater detail. The adjustment assembly 3039 includes a torsion rod assembly 4040, a torsion lever weldment 4042, and a torsion anchor assembly 4044. The torsion rod assembly 4040 includes an anchor assembly 4050, first and second retaining rings 4052a and 4052b, and an anchor eccentric 4054. The anchor assembly 4050 is a substantially oblong link having a pair of sleeve bearings 4056a and 4056b disposed within opposite ends of the anchor assembly 4050. The torsion rod assembly 4040 is fastened to the frame assembly by a pin 4060 extending through the first sleeve bearing 4056a and fastened thereto by the first retaining ring 4052a.

Rotatably disposed within the second sleeve bearing 4056b is the anchor eccentric 4054. The anchor eccentric 4054 includes a lever arm 4058 fastened to the anchor eccentric 4054 by the second retaining ring 4052b. The anchor eccentric 4054 is attached to one end of the torsion lever weldment 4042. The other end of the torsion lever weldment 4042 is keyed to an end of the torsion bar 3034.

As attached, the torsion bar 3034 extends through the torsion lever weldment 4042. The torsion lever weldment 4042 extends through the torsion anchor assembly 4044 and is seated in one end of the torsion anchor assembly 4044. As seated within the torsion anchor assembly 4044, the torsion bar 3034 is retained therein by a

retaining ring 4062. The torsion rod assembly 4040 includes a pair of spring pins 4064a and 4064b and is rigidly fastened to the ramp assembly by a well-known lock nut 4066 and hex screw 4068.

To preload the torsion bar 3034, a hex wrench (not shown) is inserted through a bore 4070 located in one end of the lever arm 4058 and into hex bore 4070a of eccentric 4054. The lever arm 4058 and eccentric 4054 are rotated into the position illustrated in FIGURE 50. A well-known hex-head cap screw 4072 is inserted into the other end of the lever arm 4058 and into an internally threaded bore (not shown) located substantially midway between the first and second sleeve bearings 4056a and 4056b of the anchor assembly 4050. To remove the preload from the torsion bar 3034, the hex-head cap screw 4072 is removed and the lever arm 4058 of the anchor eccentric 4054 is rotated substantially 180° from the position illustrated in FIGURE 50.

Referring now to FIGURES 51 and 52, the drive assembly 3024 will be described in greater detail. The drive assembly 3024 includes a gear motor 3052 and an idler and roller chain assembly 3054. The well-known gear motor 3052 is connected to a clutch 3028, which is connected to the idler and roller chain assembly 3054. The gear motor 3052 is keyed to the rotation of the ramp platform 3044 by way of the idler and roller chain assembly 3054. A suitable gear motor 3052 is Model Number IM-15, manufactured by Globe Motor.

As best illustrated in FIGURE 52, the idler and roller chain assembly 3054 includes first and second sprocket assemblies 4080a and 4080b, an idler assembly 4082, a chain tension assembly 4084, and a drive chain 3056. The first sprocket assembly 4080a is fixed to one end of the second stub shaft 3046b, which is in turn keyed to rotation of the ramp platform 3044. As an alternative, the first sprocket assembly 4080a may be integral with the second stub shaft 3046b. Rotation of the first sprocket 4080a is keyed to the rotation of the second sprocket 4080b by the drive chain 3056.

The second sprocket assembly 4080b includes a retainer 4088, a retaining ring 4090, and a sprocket 4092. The second sprocket assembly 4080b is keyed to the clutch shaft 4154 at hex key 4154a (FIGURE 57).

Still referring to FIGURE 52, the chain tension assembly 4084 will now be described in greater detail. The chain tension assembly includes a chain tension weldment 4100, an idler 4102, a spacer 4104, and a square head set screw 4106. The chain tension weldment 4100 is keyed to the drive chain 3056 and includes a torsion arm

retainer 4108 and a retaining ring 4110. A pair of cap screws 4112a and 4112b extends through opposite ends of the spacer 4104 and is operatively coupled to the set screw 4106.

Chain tension weldment 4100 is keyed at 4100b and 4100c and moves slideably on frame 3999 at guides 3999b and 3999c, respectively. Guides 3999b and 3999c form opposite sides of slot 3999a. The head of set screw 4106 rests against the end of slot 3999a. Chain tension weldment is also slotted along the axis of set screw 4106 to allow clamping action when cap screws 4112a and 4112b are tightened.

As coupled to the set screw 4106, the tension in the drive chain 3056 may be adjusted to increase or decrease the tension in the drive chain 3056 by unclamping setscrew 4106 by loosening cap screws 4112a and 4112b, turning set screw 4106, which moves chain tension weldment 4100 and thus idler 4102 along guides 3999b and 3999c, then clamping set screw 4106 by tightening cap screws 4112a and 4112b.

Referring now to FIGURES 53-56, the rising floor 3026 will now be described in greater detail. The rising floor 3026 is similar in material and operation to the moving floor 26 and 1026 (FIGURES 2 and 15), except that when the ramp assembly is in the deployed position, the rising floor 3026 is made substantially flush to the vehicle floor by way of a cam and roller assembly 3062 (FIGURE 54) instead of a pivot and link assembly 46.

The rising floor 3026 includes a floor weldment 4120, attachment arms 4122, and roller assemblies 4124. The floor weldment 4120 is substantially rectangular and forms the outside perimeter frame structure for the rising floor 3026. The attachment arms 4122 are suitably integrally formed with the floor weldment 4120 and project upwardly from the planar area of the rising floor 3026. The free ends of the attachment arms 4122 include a notch 4126 formed in the lower surface of each attachment arm 4122. The notches 4126 are sized to be slidably received on a pin 4128 projecting inwardly from each side of the ramp platform 3044 in an opposing manner. Attachment arms 4122 are similar in material and operation of lugs 60 of the first embodiment.

As seen best by referring to FIGURE 54, the roller assembly 4124 includes a sleeve bearing 4130 and a retaining ring 4132. The roller assembly 4124 is coupled to the interior facing side of the frame weldment 4120 on a pin 4134. The roller assembly 4124 is fastened to the pin 4134 by the retaining ring 4132. As is described in greater detail below, the roller assembly 4124 is adapted to be received within a cam

plate 4140. Although a single roller assembly 4124 is illustrated, it should be apparent that a second roller assembly identical to the first roller assembly 4124 is located on the opposite side of the frame weldment 4120, such that a pair of roller assemblies 4124 is located on opposite sides of the frame weldment 4120.

In operation, as the rising floor 3026 strokes with the rotation of the ramp platform 3044, it raises and is maintained at a level substantially flush with the adjacent vehicle floor (not shown), whether the ramp is deployed to a high curb or to ground level. To facilitate removal of the rising floor 3026, the cam plate 4140 is open above the roller and the lugs 4122 on the outboard end, which captures the trunnion pins 4128 on the ramp, are open on the bottom 4126. Therefore, there are no pins or fasteners to remove in order to remove the rising floor from the ramp assembly.

As best seen by referring to FIGURES 54-56, the cam plate 4140 is suitably formed from material, such as steel. The cam plate 4140 is contoured to position the rising floor 3026, such that it is either flush with the vehicle floor when the ramp assembly is in the deployed position or in a nested position when the ramp assembly is in the stowed position. In that regard, the cam plate 4140 includes a raised flat surface 4142, a sloping surface 4144, and a lower flat surface 4146.

As noted above, the roller assembly 4124 is sized to be received within the cam plate 4140, such that when the roller assembly 4124 is positioned on the raised flat surface 4142, the rising floor 3026 is flush with the vehicle floor. When the roller assembly 4124 is seated on the lower flat surface 4146 of the cam plate 4140, the rising floor 3026 is in a position below the vehicle floor, such that the articulating portion of the ramp platform 3044 is disposed on top of the rising floor 3026. As disposed on top of the rising floor 3026, the articulating portion of the ramp platform 3044 is flush with the vehicle floor, thereby providing a level floor within the vehicle. The sloped surface 4144 extends between the raised flat surface 4142 and the lower flat surface 4146 to provide a smooth transition between the deployed and stowed positions.

Referring now to FIGURES 57-59, the clutch assembly 3028 will now be described in greater detail. The clutch assembly 3028 includes a clutch hub 4150, a clutch housing 4152, and a clutch shaft 4154. The clutch hub 4150 is suitably a cylindrical member having a centrally located bore 4156 extending through the length of the clutch hub 4150. The bore 4156 is sized and adapted to receive the output shaft of the gear motor 3052, and is fastened to the output shaft by well-known fasteners, such as a

key and set screw (not shown), extending through fastener holes 4158 located in the clutch hub 4150. The clutch hub 4150 is coupled to the clutch housing 4152 by well-known pins 4160 extending through the clutch housing 4152 and into the clutch hub 4150. As attached to the clutch housing 4152, torque is transferred from the clutch hub 4150 to the clutch housing 4152. Each pinhole of the clutch housing 4152 is sized to receive pins 4160 with sufficient clearance to allow the clutch assembly to center itself.

The clutch housing 4152 is hex-shaped in cross-section and is suitably a tubular member sized to slidably receive the clutch shaft 4154 therein. The clutch shaft 4154 includes a plurality of friction disks 4162 and stainless steel shims 4164. The clutch assembly 3028 also includes a spacer 4166, a spring pad 4168, a spring washer 4170, and first and second hex jam nuts 4172 and 4174. The outside diameter of the friction discs 4162 is hex-shaped to key with the interior of the clutch housing 4152 and, therefore, rotates with the clutch hub 4150 and the clutch housing 4152. The interior diameter of each shim 4164 is hex-shaped to key with the exterior of the clutch shaft 4154.

A retaining ring 4176 is disposed at one end of the clutch shaft 4154. Alternating friction discs 4162 and shims 4164 are slidably stacked on the clutch shaft 4154. The spacer 4166 is disposed between the spring pad 4168 and the last friction disc 4162. The spring washer 4170 is then slidably disposed on the clutch shaft 4154, and then the first and second hex jam nuts 4172 and 4174 are threadably fastened to the clutch shaft 4154, thereby fastening the structure to the clutch shaft 4154. As an alternative, a suitably sized compression spring may be used in lieu of spring washer 4170. The assembled clutch shaft 4154 is then slidably received within the clutch housing 4152, such that one end of the clutch shaft 4154 is radially seated within the clutch hub 4150. The other end of the clutch shaft 4154 extends outwardly from the clutch housing 4152 and is keyed for a drive sprocket 4092 (*see* FIGURE 52). The other end of the clutch shaft 4154 also extends through frame 3999 at bearing 3998 (*see* FIGURE 51).

Referring now to FIGURES 55, 56, and 60-68, the stow latch assembly 3030 will now be described in greater detail. The stow latch assembly 3030 includes a locking assembly 4190 and a handle assembly 3096. As best seen by referring to FIGURES 55 and 56, the locking assembly 4190 includes a latch plate 4194, a stop block 4196, a linkage assembly 4198, and a solenoid 4200. The latch plate 4194 is formed from a substantially flat rectangular plate of a thin gauge spring steel folded over onto itself,

such that a live spring hinge 4202 is formed at the bend in the plate. As formed, the spring hinge 4202 extends between an attachment portion 4204 and a latch portion 4206.

The attachment portion 4204 is fixed to the ramp frame 3999 by well-known fasteners 4208, such as screws or rivets.

The free end of the latch portion 4206 is suitably bent to form a seat 4212. The seat 4212 is adapted to receive a portion of the linkage assembly 4198, as is described in greater detail below.

The stop block 4196 is suitably formed from a material, such as steel, and is a substantially rectangular member fastened to the ramp frame 3999 at a position below the locking assembly 4190. The stop block 4196 is rigidly attached to the ramp frame 3999 by well-known fasteners, such as bolts or rivets. The stop block 4196 is adapted to support the ramp platform in the stowed position, wherein the handle block 3116 of handle assembly 3096 bears on stop block 4196 (*see* FIGURE 64). A portion of the linkage assembly 4198 is pivotally attached to the stop block 4196.

As may be best seen by referring to FIGURES 55, 56, and 62, the linkage assembly 4198 includes a latch release lever 4220, an actuating link 4222, and a coil spring 4224. The latch release lever 4220 is a substantially rectangular member pivotally attached to the stop block 4196 by a pin 4226 extending laterally through the midsection of the latch release lever 4220. One end of the latch release lever 4220 is disposed against the seat 4212 of the latch plate 4194. The other end of the latch release lever 4220 is coupled to one end of the actuating link 4222 by a pin (not shown). As attached to the latch release lever 4220, the actuating link 4222 pivots the latch release lever 4220 about the pin 4226 to displace the latch portion 4206 into an unlocked position (FIGURE 56), such that the seat 4212 of latch plate 4194 disengages handle block 3116.

The other end of the actuating link 4222 is operatively connected to the solenoid 4200 and the coil spring 4224. As best seen by referring to FIGURE 62, the actuating link 4222 is bent at two right angles, such that one end of the actuating link 4222 forms a substantially reverse S-shape. The coil spring 4224 extends between an attachment bore 4228 and an attachment arm 4230. The attachment arm 4230 is rigidly attached to the ramp frame 3999 in a manner well known in the art. As attached, the coil spring 4224 biases the stow latch assembly 3030 into the locked position, as seen best by referring to FIGURE 55.

Referring now to FIGURES 67 and 68, the handle assembly 3096 will now be described in greater detail. Attached to the outboard side of the ramp platform 3044, the handle assembly 3096 includes a pull handle 3112, handle bias spring 3114, and a handle block 3116.

The operation of the stow latch assembly 3030 is best seen in FIGURE 64, where the latch plate 4194 engages the handle block 3116 when the ramp platform 3044 is in the stowed position. During normal powered operations, when deploy is selected, the solenoid 4200 actuates the latch release lever 4220, which in turn causes the latch plate 4194 to disengage the handle block 3116 (FIGURE 66). When deploying the ramp manually from the stowed position, the operator lifts the pull handle 3112, which disengages the latch plate 4194 from the handle block 3116, enabling the operator to simply lift up the ramp platform 3044.

Referring now to FIGURES 69-89, another embodiment of a fold-out ramp assembly 5020 of the current invention will now be described. This embodiment is identical in materials and operation to the invention described above, with a few exceptions. In that regard, portions of an adjustment assembly 5039, a counterbalance linkage assembly 6000, and a torsion bar 5034 have been modified as described below. Inasmuch as the remaining elements of this embodiment are identical in materials and operation to the embodiments described above, for the sake of brevity, they will not be redundantly described below.

As may best be seen by referring to FIGURES 69-72, the adjustment assembly 5039 of the present embodiment will now be described. Generally, the adjustment assembly 5039 provides an assembly to adjust the magnitude or amount of a preload or torque applied to a ramp 5021 to counterbalance the weight of the ramp 5021 during deployment and stowage. The adjustment assembly 5039 includes a yoke 5024 adjustably coupled to a pivot block 5030. A first end of the yoke 5024 includes a clevis 5025 pivotally coupled to a torsion lever arm 5042 by a pin 5032. A second end of the yoke 5024 is adjustably coupled to the pivot block 5030 by a loading screw 5028. The loading screw 5028 is suitably an externally threaded fastener having threads sized and configured to be threadably received within a set of internal threads (not shown) disposed in the second end of the yoke 5024. Through rotation of the loading screw 5028, the spacing of the pin 5032 from the pivot block 5030 may be selectively

adjusted, thereby causing a corresponding rotation of the torsion lever 5042 and a torsion bar attached thereto, as described in further detail below.

A base portion of a head 5044 of the loading screw 5028 includes a spherically-shaped mating surface 5040 sized and shaped to be received within a correspondingly spherically-shaped mating surface 5041 on the pivot block 5030. The interfacing spherically shaped mating surfaces 5040 and 5041 may be angularly displaced to accommodate misalignment of the pivot block 5030 relative to the yoke 5024, thereby accommodating changes in yoke 5024 angle as the adjustment assembly 5039 is adjusted.

Focusing now on the pivot block 5030, the pivot block 5030 includes an inner passageway to accommodate the passage of the loading screw 5028 therethrough. The pivot block 5030 suitably couples the yoke 5024 to a frame side rail 5035 of the fold-out ramp assembly 5020. As best seen by referring to FIGURE 70, the pivot block 5030 includes a groove 5036 that engages a tongue 5038 in the frame side rail 5035. The tongue 5038 and groove 5036 are correspondingly sized and shaped to allow the tongue 5038 to slidingly engage the groove 5036, thereby coupling the pivot block 5030 to the frame side rail 5035.

Referring now to FIGURES 71 and 72, a guard 5026 for impeding the removal of a torsion lever arm assembly 5022 from the frame side rail 5035 when the adjustment assembly 5039 is in a loaded condition, will now be described. The guard 5026 is coupled to the yoke 5024 and includes first and second blocking prongs 5046 and 5048. The blocking prongs 5046 and 5048 are sized and positioned to impede the removal of a first mounting screw 5050 and a second mounting screw 5052 when the adjustment assembly 5039 is in a loaded condition, *i.e.*, wherein the torsion bar 5034 (*see* FIGURE 73) is in a twisted position. The first and second mounting screws 5050 and 5052 couple the torsion lever arm assembly 5022 to the frame side rail 5035. When the adjustment assembly 5039 is in the loaded condition, the first and second blocking prongs 5046 and 5048 are positioned on the outboard side of the first and second mounting screw 5050 and 5052. As such, the blocking prongs 5046 and 5048 selectively block access to mounting screws 5050 and 5032 and, thereby, prevent removal of the mounting screws 5050 and 5052.

Referring now to FIGURE 72, the adjustment assembly 5039 may be placed in an unloaded condition by rotating the loading screw 5028. Rotating the loading screw 5028 changes the effective length of yoke 5024. From a viewpoint at the head of the unloading

screw 5028, a counter-clockwise rotation increases the length of the yoke 5024. This increased length causes a rotation of torsion lever arm 5042 within torsion lever arm assembly 5022 and untwists torsion bar 5034. Thus the preload torque applied by the torsion lever arm 5042 upon the torsion bar 5034 is relieved, thereby placing the torsion bar 5034 in a non-twisted or neutral position, referred to as an unloaded condition.

In the unloaded condition, as depicted in FIGURE 72, the guard 5026 has moved into a position where the first and second blocking prongs 5046 and 5048 no longer substantially impede access to the first and second mounting screws 5050 and 5052 allowing removal of the torsion lever arm assembly 5022. Thus, it should be apparent to one skilled in the art that the guard 5026 impedes the removal of the first and second mounting screws 5050 and 5052 when the torsion bar 5034 is in a twisted or loaded condition and allows access to the screws 5050 and 5052 when the torsion bar 5034 is in the unloaded condition.

Still referring to FIGURE 72, the pivot block 5030 may be disengaged from the yoke 5024 by rotation of the loading screw 5028 until a point where the loading screw 5028 disengages from the yoke 5024. The pivot block 5030 may then slide, either back or forth, as shown by the arrow indicated by reference numeral 5054, to disengage the tongue 5038 (FIGURE 70) from the groove 5036 in the pivot block 5030. After the tongue 5038 is disengaged from the groove 5036, the pivot block 5030 may be pulled outward free and clear of the fold-out ramp assembly 5020. As should be apparent to one skilled in the art, the removal of the pivot block 5030 may only be accomplished when the torsion bar is in the unloaded condition. Pin 5032 can now be removed through access hole 5056 in frame rail 5035. Then yoke 5024 can be removed clear of the ramp assembly 5020. Pin 5032 has a head such that when the adjustment assembly 5039 is loaded, the head of the pin is captive between the inboard surface of clevis 5025 and the frame slide rail 5035.

Referring to FIGURES 73-77, the torsion lever arm assembly 5022 will now be described in further detail. The torsion lever arm assembly 5022 includes a bracket 5062, the torsion lever arm 5042, and a bearing block 5082. Referring to FIGURES 76 and 77, the torsion lever arm bracket 5062 is generally an elongate rectangular-shaped block. A first end of the torsion lever arm bracket 5062 includes first and second mounting screw apertures 5072 and 5074. The mounting screw apertures 5072 and 5074 allow the

coupling of the torsion lever arm bracket 5062 to the frame side rail 5035 through the use of the first and second mounting screws 5050 and 5052 (*see* FIGURE 72).

The second end of the torsion lever arm bracket 5062 includes first and second fastener apertures 5086 and 5088. The fastener apertures 5086 and 5088 allow the coupling of the bearing block 5082 to the torsion lever arm bracket 5062 by first and second fasteners 5068 and 5070. The torsion lever arm bracket 5062 further includes a torsion bar access hole 5090 located between the first and second fastener apertures 5086 and 5088. The torsion bar access hole 5090 allows the torsion bar to extend through the access hole 5090 to engage the torsion lever arm 5042. Once bracket 5062 is attached to frame side rail 5035, the first and second fasteners 5068 and 5070 are not accessible. Thus, all the features of adjustment assembly 5039 form a safety assembly requiring that the torsion bar 5034 be unloaded before the removal of any mounting fasteners or pins.

Referring FIGURE 76, the torsion lever arm 5042 will now be described in further detail. The torsion lever arm 5042 includes a circular base portion 5092 integrally formed with an arm 5094. Concentrically located in the circular base portion 5092 is a lobed spline receptacle 5064 for receiving a correspondingly shaped lobed spline end 5096 of the torsion bar 5034 (*see* FIGURES 78 and 79). The lobed spline interconnection of the torsion lever arm 5042 to the torsion bar 5034 keys the torsion lever arm 5042 to the torsion bar 5034, while also providing a large contact surface area and reduced pressure angles between mating parts to increase the strength of the coupling. Located at a distal end of the arm 5094 is a pin-receiving aperture 5098 sized and shaped to receive the pin 5032 that interconnects the yoke 5024 (*see* FIGURE 70) to the arm 5094.

Still referring to FIGURES 76 and 77, the bearing block 5082 will now be described in greater detail. The bearing block 5082 includes a rectangular-shaped base plate 5100. Integrally formed on opposite ends of the base plate 5100 are first and second saddle bearings 5076 and 5078. Opposed ends of the first and second saddle bearings 5076 and 5078 each includes an arcuate surface 5102. The curvature of the arcuate surfaces 5102 is sized and shaped to correspond to the circular base portion 5092 of the torsion lever arm 5042. As such, the first and second saddle bearings 5076 and 5078 cradle the circumferential surface of the torsion lever arm 5042 within the arcuate surfaces 5102, thereby impeding the movement of the lever arm 5042 in a direction other than rotary.

To reduce wear and friction, and thereby assist the rotary motion of the torsion lever arm 5042, the first and second saddle bearings 5076 and 5078 each further includes a strip of bearing material 5080 having a low coefficient of friction. The bearing material 5080 is secured to the arcuate surfaces 5102 of the saddle bearings 5076 and 5078 by well-known fasteners 5084, such as rivets.

Referring now to FIGURES 80-89, the counterbalance linkage assembly 6000 of the fold-out ramp assembly 5020 will now be described in further detail. The counterbalance linkage assembly 6000 is suitably located on a side of the ramp assembly 5020 opposite the adjustment assembly 5039, shown in FIGURE 69. As seen best by referring to FIGURES 81-83, the counterbalance linkage assembly 6000 includes a torsion lever assembly 6022 and a counterbalance actuating arm 6002. The torsion lever assembly 6022 is similar in design and operation as the torsion lever arm assembly 5022 shown in FIGURES 69-79, and therefore will not be discussed in further detail here. The counterbalance actuating arm 6002 is similar in design and operation to the actuating arm 3038 depicted in FIGURES 47-49. Therefore, for brevity, this detailed description will focus on the distinguishing aspects of the counterbalance actuating arm 6002 of this embodiment.

Referring to FIGURES 81-89, the counterbalance actuating arm 6002 is suitably coupled to the torsion lever arm assembly 6022 by a clevis 6020. The clevis 6020 is formed by attaching an outboard clevis plate 6004 to the outboard surface of the counterbalance actuating arm 6002 and by further placing an inboard clevis plate 6006 to the inboard surface of the counterbalance actuating arm 6002. A pin-receiving aperture 6008 is located in the outboard clevis plate 6004. Likewise, concentrically aligned with the pin-receiving aperture 6008 is a corresponding pin-receiving aperture 6010 located in the distal end of the inboard clevis plate 6006.

A pin 6009 is placed through the receiving apertures 6008 and 6010 of the clevis plates 6004 and 6006, thereby coupling the counterbalance actuating arm 6002 to the torsion lever arm assembly 6022. The pin 6009 must be aligned with a pin access hole 6012 located in the frame side rail 6024. The pin access hole 6012 is suitably located in the frame side rail 6024 in such a position so as to be concentrically aligned with the pin 6009 when the adjustment assembly 5039 is in the unloaded condition. After the adjustment assembly 5039 is placed in the unloaded condition and the pin 6009 is aligned with the pin access hole 6012, the pin 6009 may be pressed inboard and through

the pin access hole 6012. The pin 6009 may then be removed, decoupling the actuating arm 6002 from the torsion lever arm assembly 6022. Pin 6009 has a head similar to pin 5032 of the adjustment assembly 5039. The head of pin 6009 is captive between the inboard clevis plate 6006 and the frame side rail 6024 when the counterbalance linkage assembly 6000 is in the loaded position.

Referring to FIGURES 81-89, integrally formed with the outboard clevis plate 6004 are first and second blocking prongs 6016 and 6018. The first and second blocking prongs 6016 and 6108 perform the same purpose and function as the guard 5026 associated with the adjustment assembly 5039 depicted in FIGURES 70-74. Specifically, the first and second blocking prongs 6016 and 6018 impede the removal of the torsion lever arm assembly 6022 when the torsion bar is in a loaded condition. For example, referring to FIGURE 82, the counterbalance linkage assembly 6000 is shown in the loaded condition. As a result, the first and second blocking prongs 6016 and 6018 prevent the removal of first and second mounting screws 6026 and 6028. The first and second mounting screws 6026 and 6028 couple the torsion lever arm assembly 6022 to the frame side rail 6024. Referring to FIGURE 83, the counterbalance linkage assembly 6000 is shown in the unloaded condition and the first and second blocking prongs 6016 and 6018 are displaced laterally, thereby permitting the removal of the mounting screws 6026 and 6028, and thus the removal of the torsion lever arm assembly 6022 from the frame side rail 6024.

Although the preferred embodiments of the present invention have been described above, it should be apparent that changes may be made thereto and still be within the scope of the present invention. As a nonlimiting example, the cam pins may be integrally formed with the rear stub shaft. Further, a manually operated fold-out ramp is also within the scope of the present invention. In this regard, such a fold-out ramp may be manufactured without the drive assembly and, therefore, manually reciprocated between stowed and deployed positions. As another nonlimiting example, the reciprocating mechanism could independently drive the ramp and the raising floor.

While the preferred embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A ramp assembly, comprising;

(a) a frame attachable to a vehicle having a floor;

(b) a platform coupled to a portion of the frame;

(c) a ramp having a weight;

(d) a reciprocating mechanism coupled to the ramp and disposed between the ramp and platform for reciprocating the ramp between a deployed position and a stowed position in response to a load, the reciprocating mechanism applying a preload to the ramp to counterbalance the weight of the ramp during actuation of the ramp between the deployed and stowed positions to reduce the load required to reciprocate the ramp between the deployed and stowed positions; and

(e) a preload adjustment assembly coupled to the reciprocating mechanism and operable to adjust a magnitude of the preload applied to the ramp by the reciprocating mechanism.

2. The ramp assembly of Claim 1, wherein the reciprocating mechanism includes a torsion assembly having a rotating end and a fixed end.

3. The ramp assembly of Claim 2, wherein the torsion assembly includes a torsion rod extending between the fixed and rotating ends of the torsion assembly, such that when the ramp is reciprocated between the deployed and stowed positions, the weight of the ramp causes the torsion rod to twist about the fixed end into a loaded position to resist the weight of the ramp.

4. The ramp assembly of Claim 3, wherein the torsion rod further comprises a splined portion.

5. The ramp assembly of Claim 4, wherein the splined portion is comprised of a plurality of lobed shaped splines.

6. The ramp assembly of Claim 3, wherein the torsion assembly further comprising:

(a) a torsion lever coupled to the torsion rod; and

(b) a bearing coupled to the frame, wherein the torsion lever engages the bearing during rotation of the torsion lever.

7. The ramp assembly of Claim 6, wherein the bearing is a saddle bearing.

8. The ramp assembly of Claim 3, wherein the torsion assembly further comprising a torsion lever assembly coupled to the frame and the torsion rod.

9. The ramp assembly of Claim 8, wherein the torsion lever assembly comprises:

(a) a torsion lever bracket fastened to the frame;

(b) a bearing block coupled to the torsion lever bracket; and

(c) a lever rotatably disposed between the torsion lever bracket and the bearing block and is coupled to the torsion rod.

10. The ramp assembly of Claim 9, wherein the lever engages a portion of the bearing block during rotation of the lever.

11. The ramp assembly of Claim 8, further comprising a guard coupled to the reciprocating mechanism, wherein the guard is selectively actuatable between a first position to impede removal of the torsion lever assembly from the frame and a second position to permit removal of the torsion lever assembly from the frame.

12. The ramp assembly of Claim 11, further comprising coupling means for selective coupling of the torsion lever assembly to the frame.

13. The ramp assembly of Claim 12, wherein the coupling means is first and second fasteners coupling a portion of the torsion lever assembly to a portion of the frame.

14. The ramp assembly of Claim 12, further comprising a blocking mechanism formed with the frame to selectively prevent decoupling of the coupling means from the torsion lever.

15. The ramp assembly of Claim 14, wherein the blocking mechanism selectively prevents decoupling of the coupling means from the torsion lever when the torsion rod is in the loaded position.

16. The ramp assembly of Claim 3, wherein the torsion assembly further comprises an actuating arm rotatably attached to the frame and first and second bearing surfaces coupled to the ramp, wherein the first and second bearing surfaces move in a predetermined path as the ramp reciprocates between the deployed and stowed positions to contact a portion of the actuating arm and to unload and load the torsion rod.

17. The ramp assembly of Claim 16, further comprising coupling means interacting with the actuating arm for selectively coupling the actuating arm to the frame.

18. The ramp assembly of Claim 17, wherein the coupling means is selectively impeded from removal when the torsion rod is in the loaded position.

19. The ramp assembly of Claim 16, wherein one end of the actuating arm includes a cam surface positioned for engagement with at least one of the first and second bearing surfaces, such that as the ramp is reciprocated between the deployed and stowed positions, at least one of the first or second bearing surfaces engages a portion of the cam surface to load the torsion rod and counterbalance the weight of the ramp.

20. The ramp assembly of Claim 3, wherein the preload assembly is selectively impeded from being decoupled from the frame when the torsion rod is in the loaded position.

21. The ramp assembly of Claim 20, wherein the preload assembly includes a link assembly having an adjustable length to selectively adjust the magnitude of the preload.

22. The ramp assembly of Claim 20, wherein the preload assembly further comprising a link assembly having a first end, a second end, and a length, wherein the link assembly first end is coupled to the frame and the link assembly second end is coupled to the reciprocating mechanism.

23. The ramp assembly of Claim 22, wherein the first end of the link assembly includes a coupling device for coupling the first end to the frame, wherein the coupling device impedes the removal of the first end from the frame when the preload is applied to the ramp.

24. The ramp assembly of Claim 1, wherein the platform is coupled to the frame by a lifting assembly to reciprocably lift the platform into and out of a position substantially flush with the floor of the vehicle when the ramp is reciprocated between the deployed and stowed positions.

25. The ramp assembly of Claim 24, wherein the lifting assembly comprises a cam attached to the frame and a cam follower fastened to the platform.

26. A ramp assembly, comprising:

(a) a frame attachable to a vehicle having a floor;

(b) a platform coupled to a portion of the frame;

(c) a ramp having a lower surface and a weight;

(d) a reciprocating mechanism coupled to the ramp and disposed between the ramp and platform for reciprocating the ramp between a deployed position and a stowed position in response to a load;

(e) a lifting assembly disposed between the platform and the frame to reciprocably displace the platform into and out of a position substantially flush with the floor as the ramp is reciprocated between the deployed and stowed positions; and

(f) a preload adjustment assembly coupled to the reciprocating mechanism and operable to adjust a magnitude of a preload applied to the ramp by the reciprocating mechanism.

27. The ramp assembly of Claim 26, wherein the reciprocating mechanism includes a torsion rod having a fixed end and a second end in communication with the ramp, such that when the ramp is reciprocated between the deployed and stowed positions, the weight of the ramp causes the torsion rod to twist about the fixed end of the torsion rod into a loaded position to resist the weight of the ramp.

28. The ramp assembly of Claim 27, wherein the reciprocating mechanism further comprising a torsion lever assembly coupled to the frame and the torsion rod end, and a guard coupled to the reciprocating mechanism, wherein the guard is actuatable between a first position to impede removal of the torsion lever assembly from the frame and a second position to permit removal of the torsion lever assembly from the frame.

29. The ramp assembly of Claim 27, wherein the reciprocating mechanism further comprising:

(a) a torsion lever coupled to the torsion rod; and

(b) coupling means extending between the torsion lever and the reciprocating mechanism for coupling the torsion lever to the reciprocating mechanism.

30. The ramp assembly of Claim 29, further comprising a blocking mechanism coupled to the frame to selectively prevent decoupling of the fastener from the torsion lever.

31. The ramp assembly of Claim 27, wherein the reciprocating mechanism further comprises an actuating arm rotatably attached to the torsion rod and first and second bearing surfaces coupled to the ramp, wherein the first and second bearing surfaces move in a predetermined path as the ramp reciprocates between the deployed and stowed positions to contact a portion of the actuating arm and cause the torsion rod to twist.

32. The ramp assembly of Claim 31, wherein one end of the actuating arm includes a cam surface positioned for engagement with at least one of the first and second bearing surfaces, such that as the ramp is reciprocated between the deployed and stowed positions, at least one of the first or second bearing surfaces engages a portion of the cam surface to load the torsion rod and counterbalance the weight of the ramp.

33. The ramp assembly of Claim 30, further comprising a counterbalance assembly attached to the ramp assembly to counterbalance the weight of the ramp during actuation of the ramp between the deployed and stowed positions, thereby reducing the load required to reciprocate the ramp between the deployed and stowed positions.

34. The ramp assembly of Claim 33, wherein when the ramp assembly is in the stowed position, the platform is displaced into a predetermined position below the floor by the lifting assembly and the lower surface of the ramp is substantially flush with the floor.

35. A ramp assembly, comprising:

(a) a frame attachable to a vehicle having a floor;

(b) a platform coupled to a portion of the frame;

(c) a ramp having a weight;

(d) a reciprocating mechanism coupled to the ramp and disposed between the ramp and platform for reciprocating the ramp between a deployed position and a stowed position in response to a load, the reciprocating mechanism counterbalancing the weight of the ramp during actuation of the ramp between the deployed and stowed positions to reduce the load required to reciprocate the ramp between the deployed and stowed positions;

(e) a lifting assembly disposed between the platform and the frame to reciprocably displace the platform into and out of a position substantially flush with the floor as the ramp is reciprocated between the deployed and stowed positions; and

(f) a preload adjustment assembly coupled to the reciprocating mechanism and operable to adjust a magnitude of a preload applied to the ramp by the reciprocating mechanism.

36. The ramp assembly of Claim 35, wherein the reciprocating mechanism further comprising a torsion lever assembly and guard means for impeding removal of the torsion lever assembly from the frame.

37. The ramp assembly of Claim 35, wherein the reciprocating mechanism further comprises an actuating arm rotatably attached to a portion of the reciprocating mechanism and first and second bearing surfaces coupled to the ramp, wherein the first and second bearing surfaces move in a predetermined path as the ramp reciprocates between the deployed and stowed positions to contact a portion of the actuating arm and to place a torsion load on a portion of the reciprocating mechanism.

38. The ramp assembly of Claim 37, wherein one end of the actuating arm includes a cam surface positioned for engagement with at least one of the first and second bearing surfaces, such that as the ramp is reciprocated between the deployed and stowed positions, at least one of the first or second bearing surfaces engages a portion of the cam surface to counterbalance the weight of the ramp.

39. The ramp assembly of Claim 38, wherein when the ramp assembly is in the stowed position, the platform is displaced into a predetermined position below the floor by the lifting assembly and a lower surface of the ramp is substantially flush with the floor.

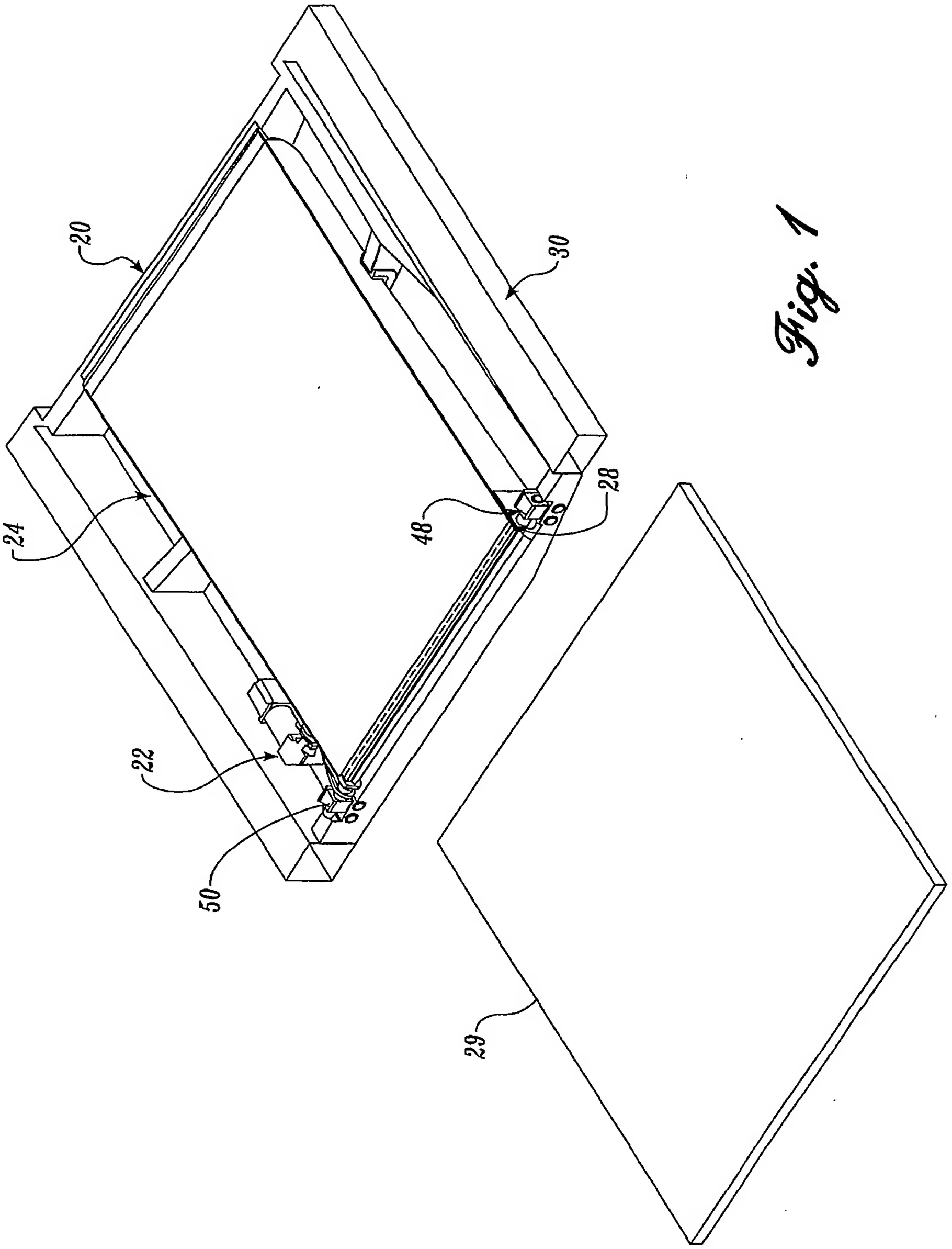


Fig. 1

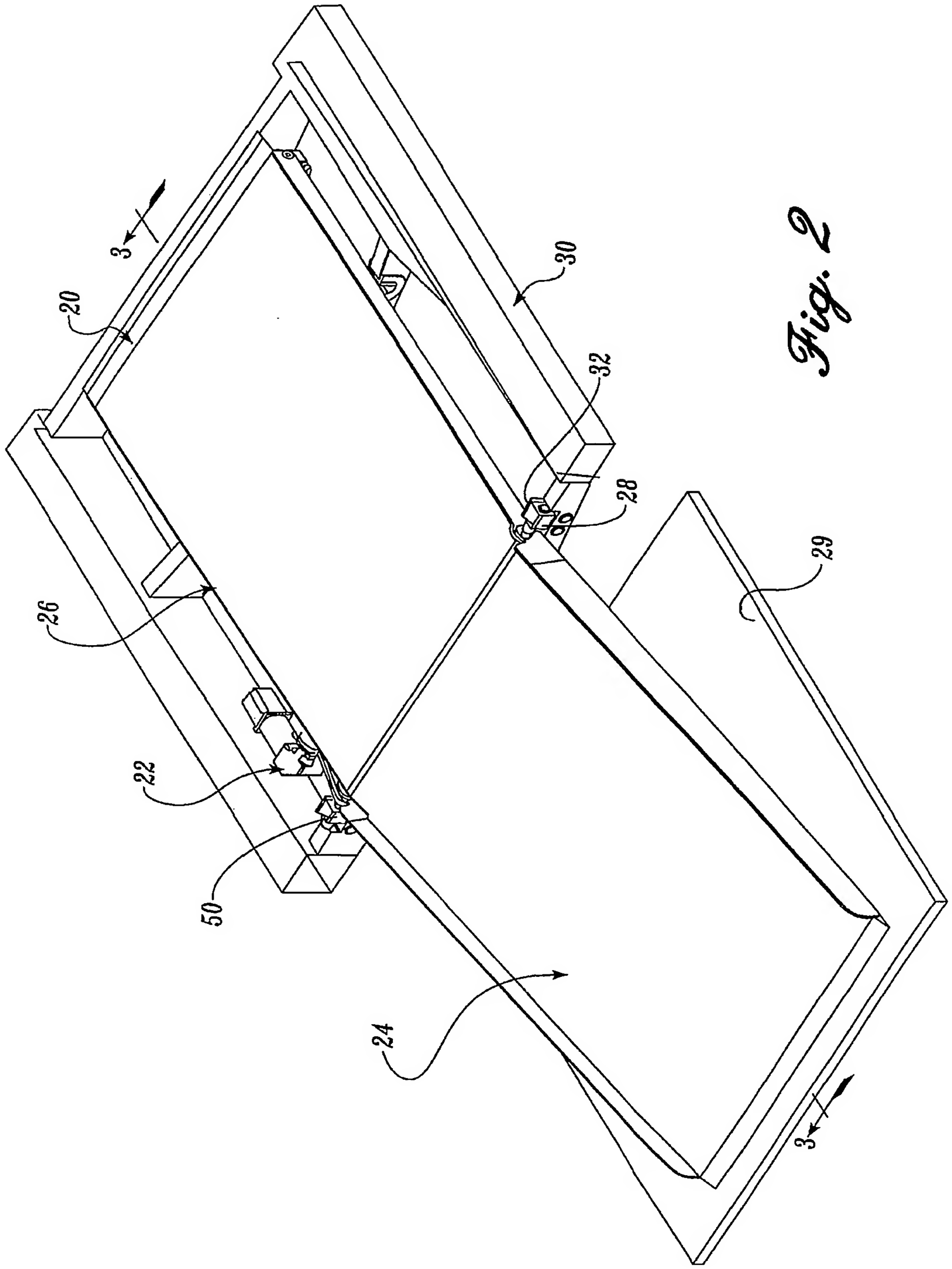


Fig. 2

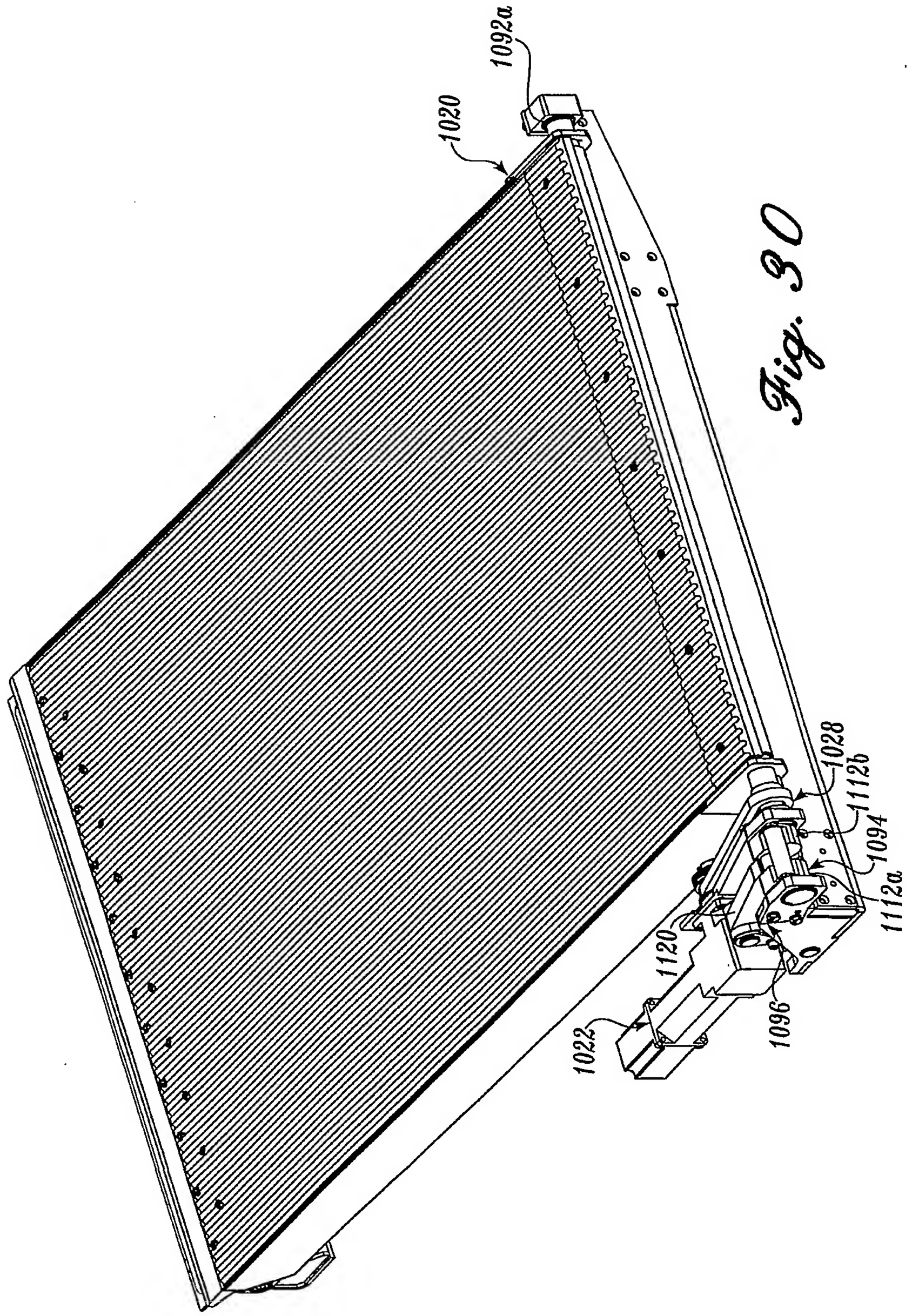


Fig. 30

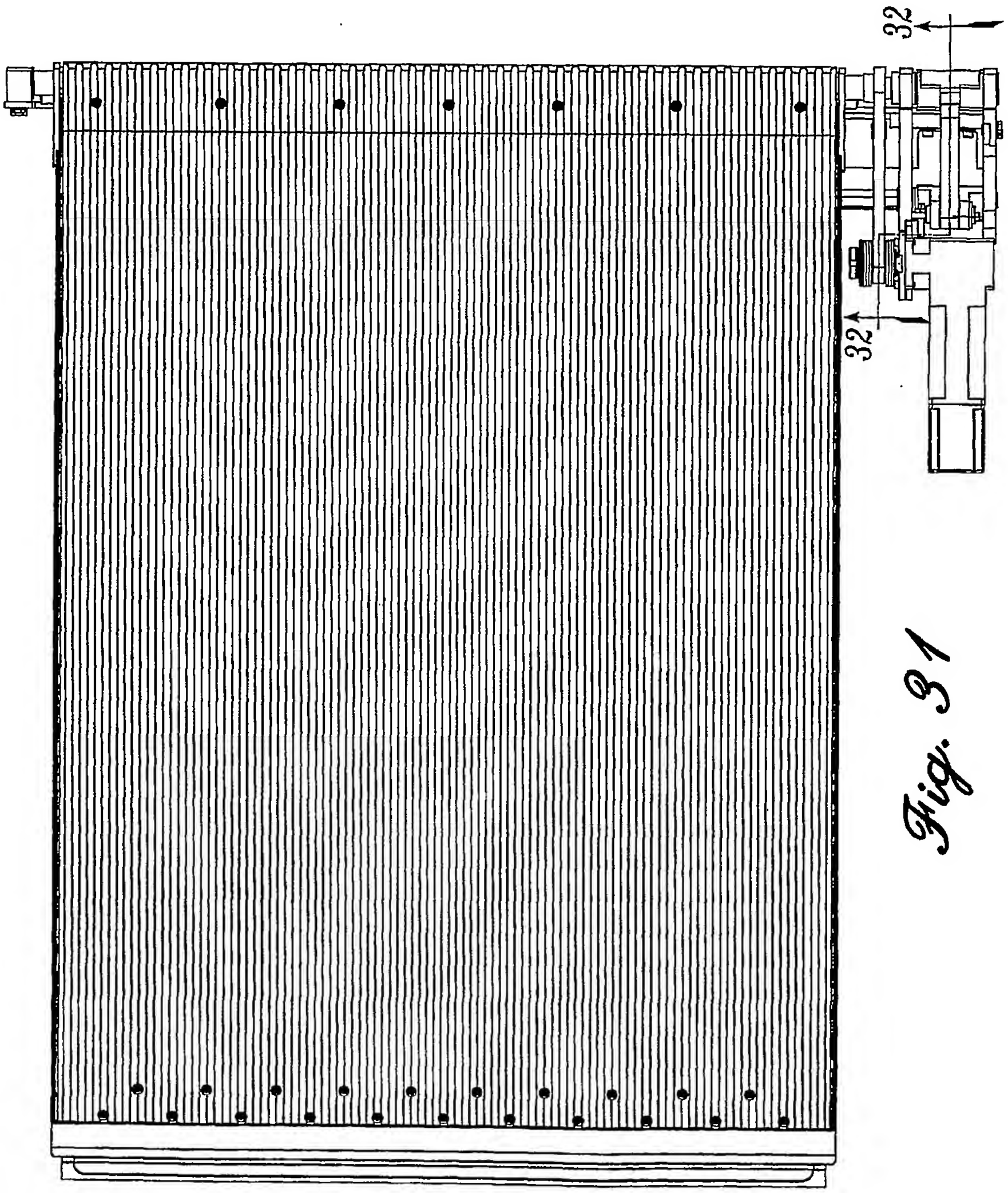


Fig. 31

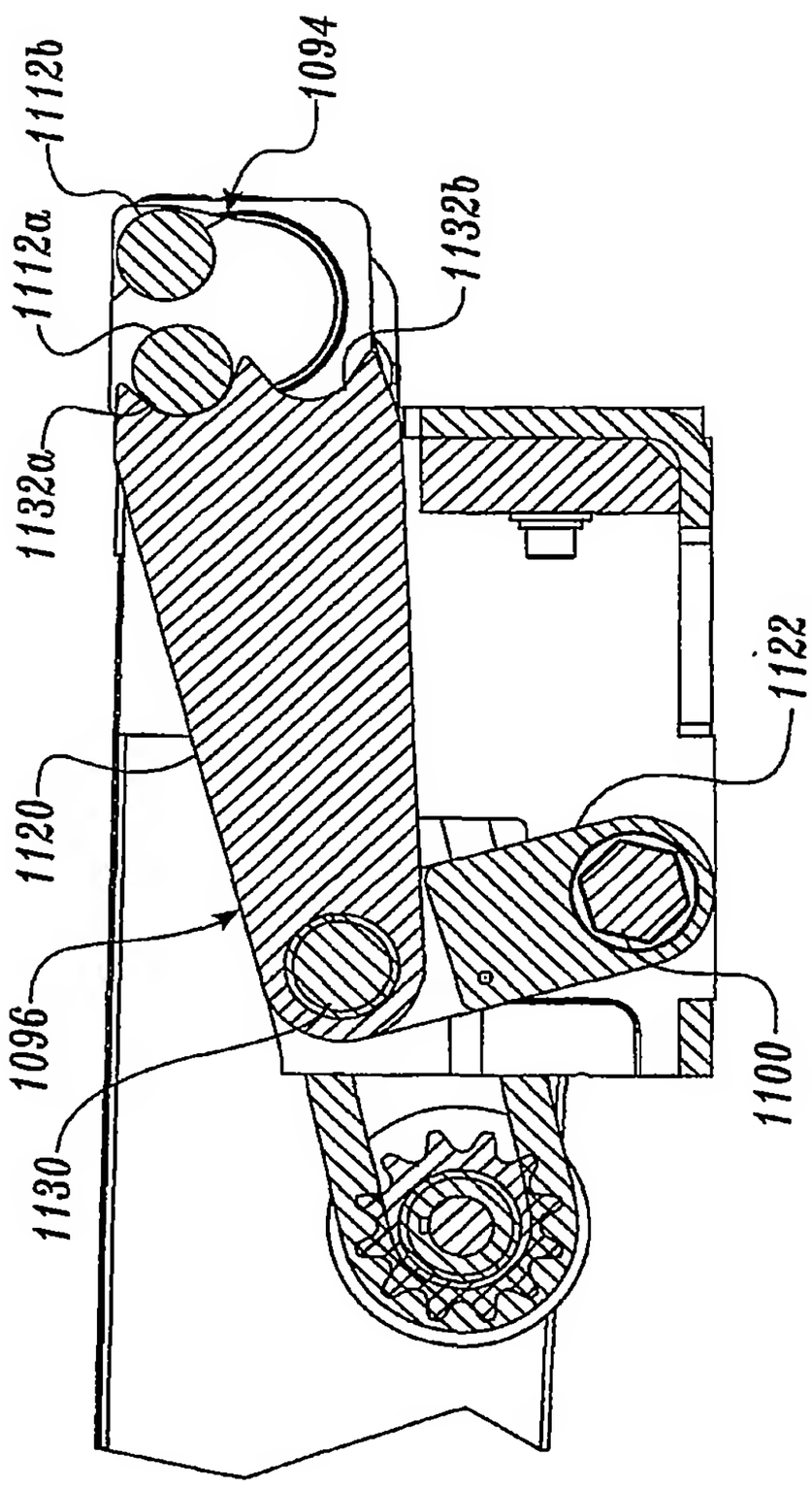


Fig. 32

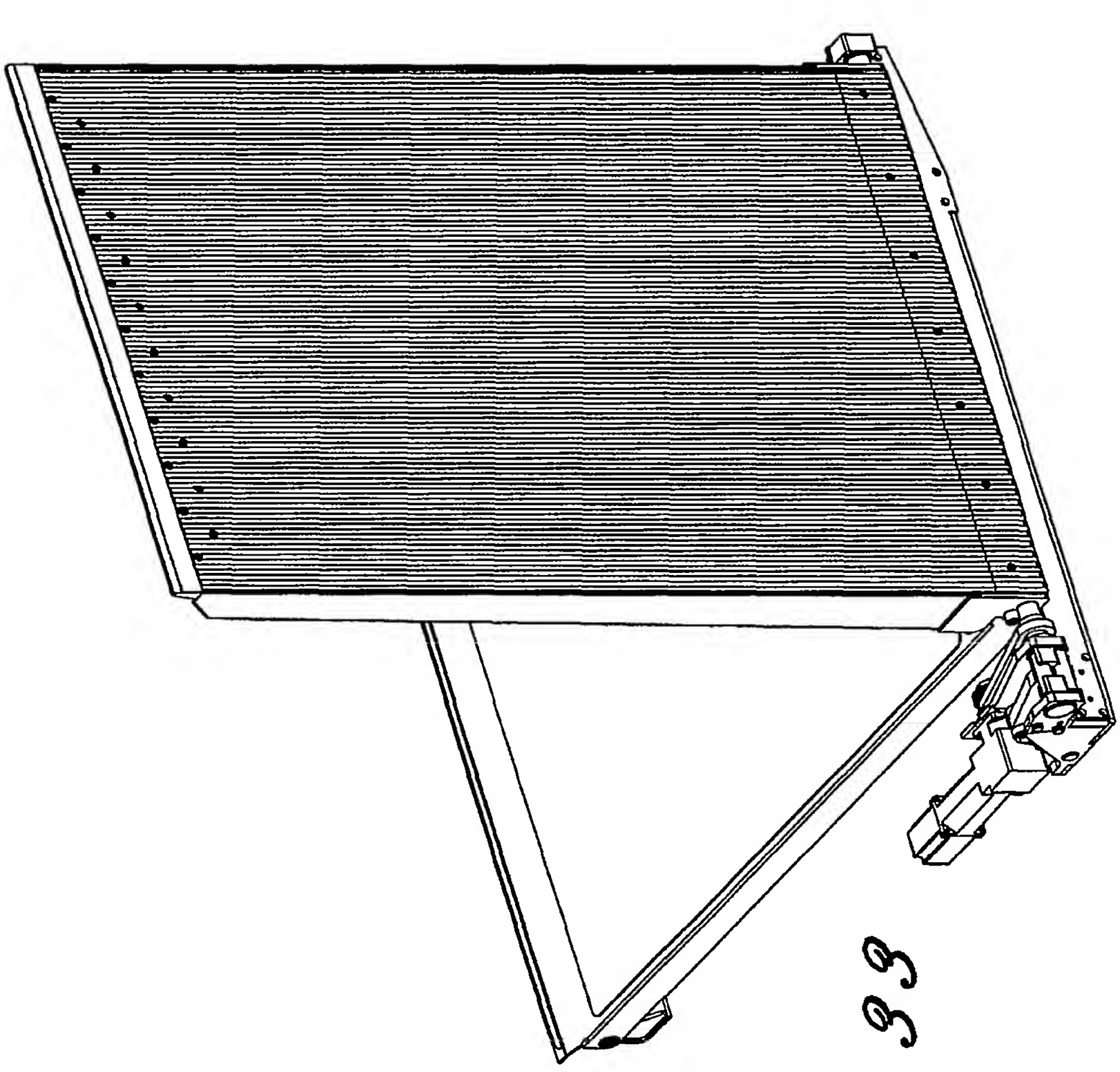


Fig. 3 3

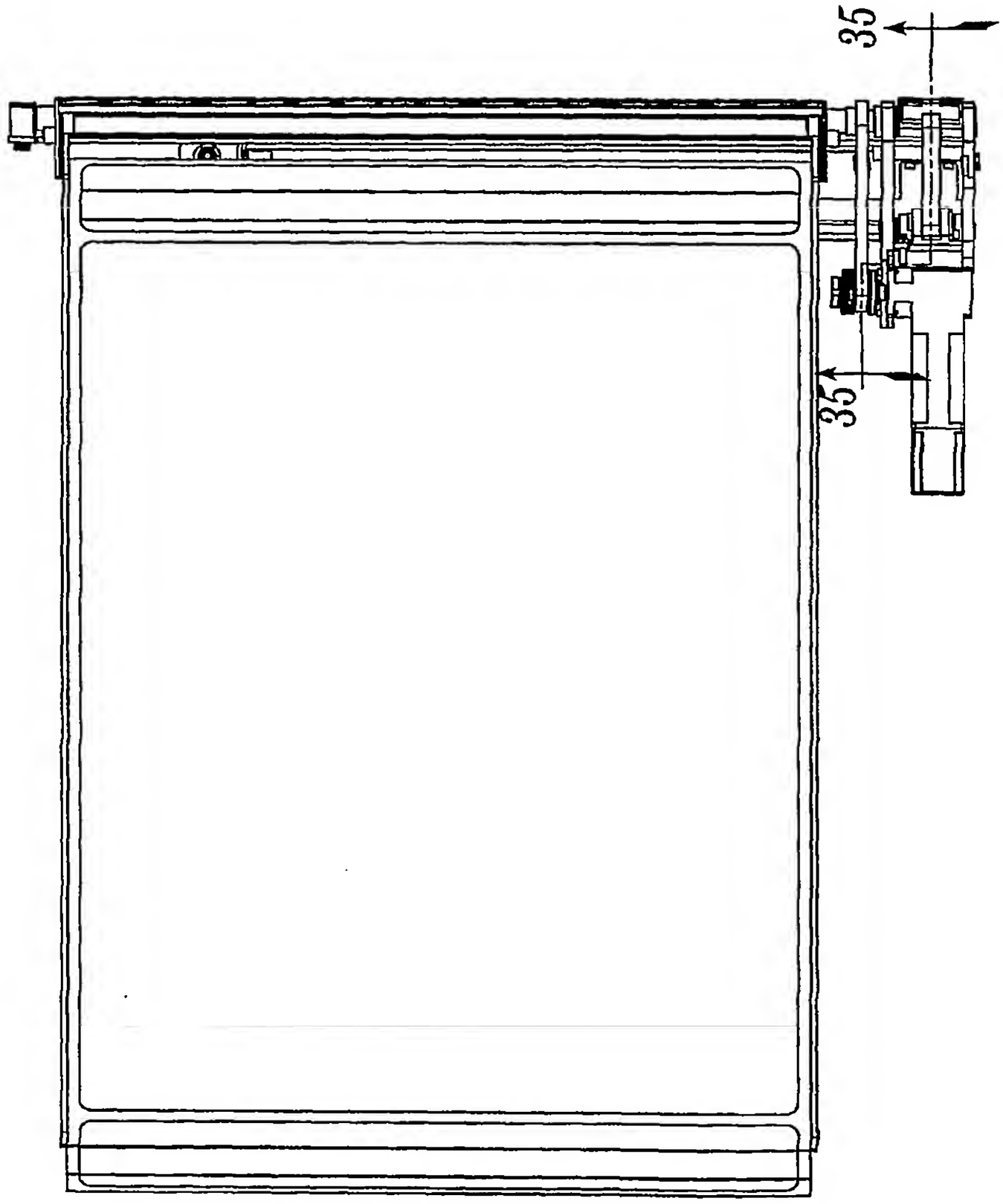


Fig. 34

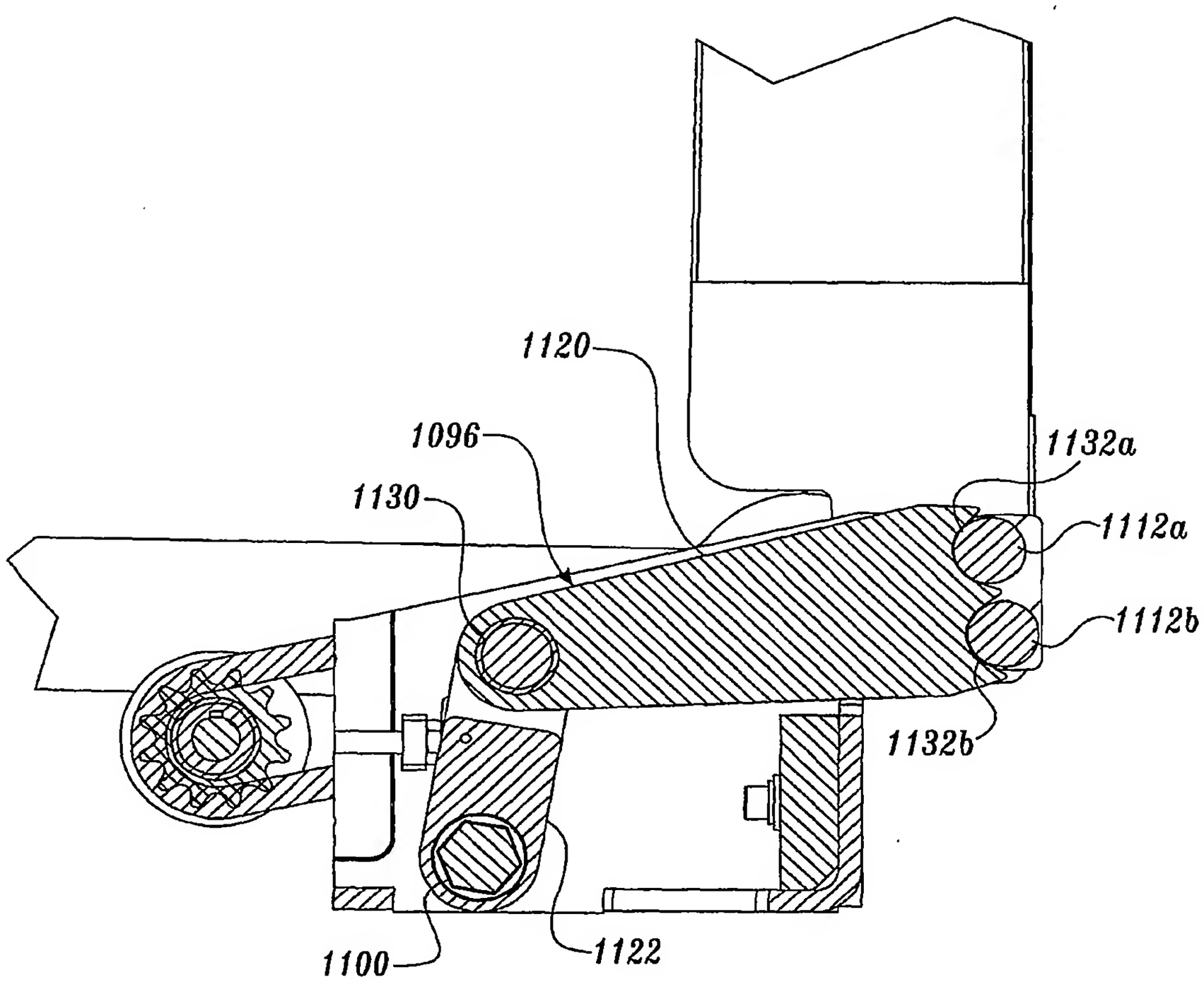


Fig. 35

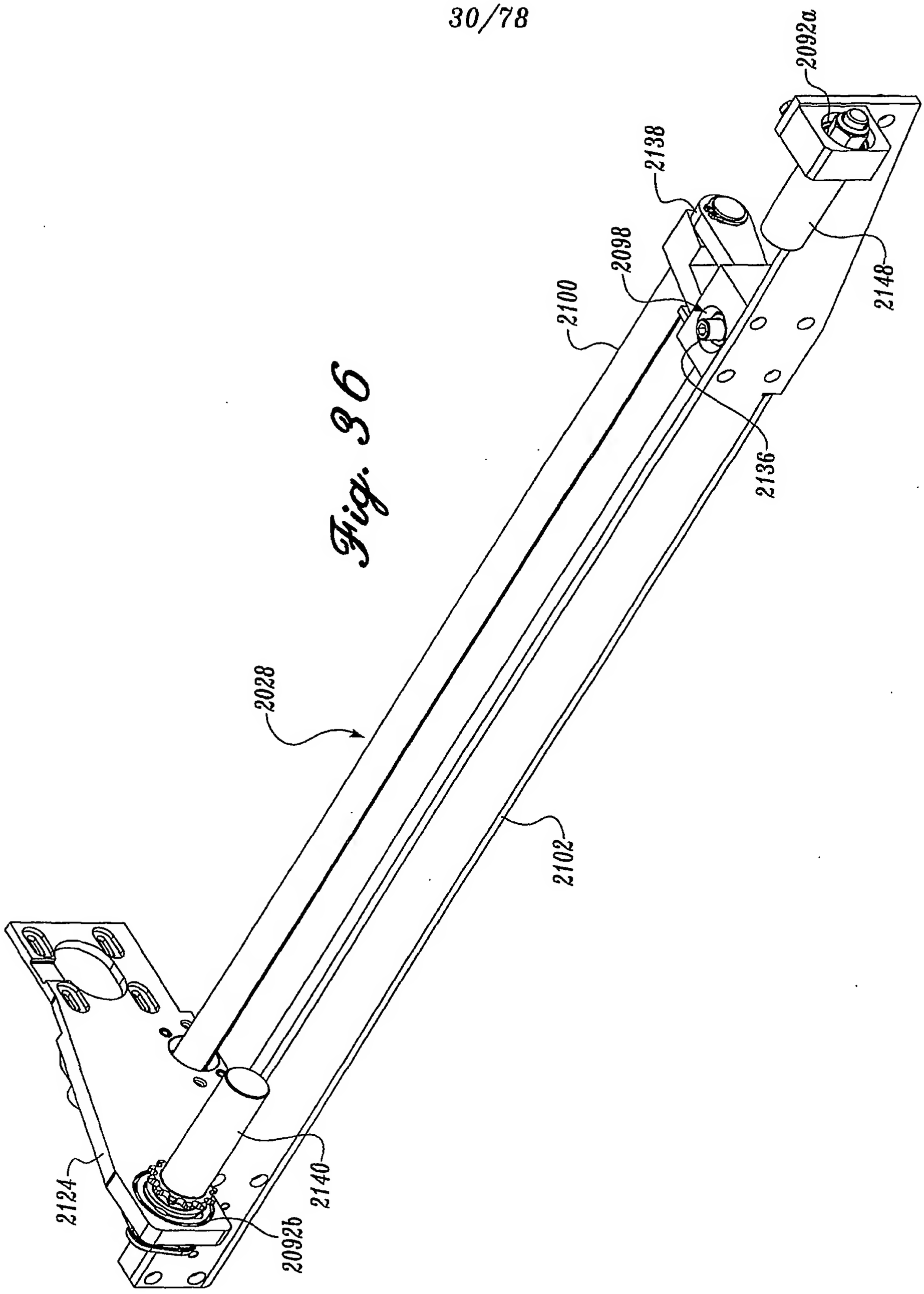


Fig. 36

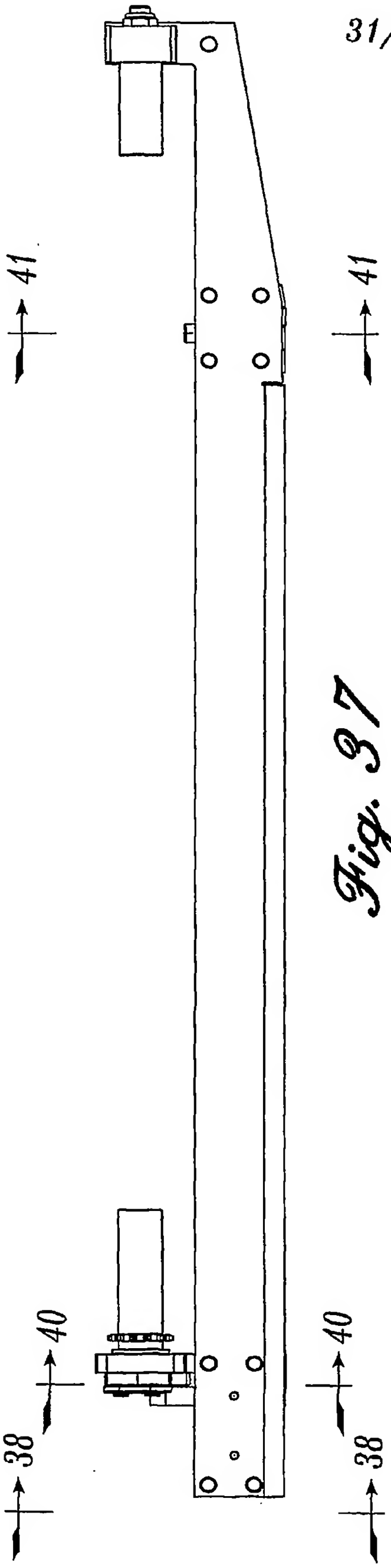


Fig. 37

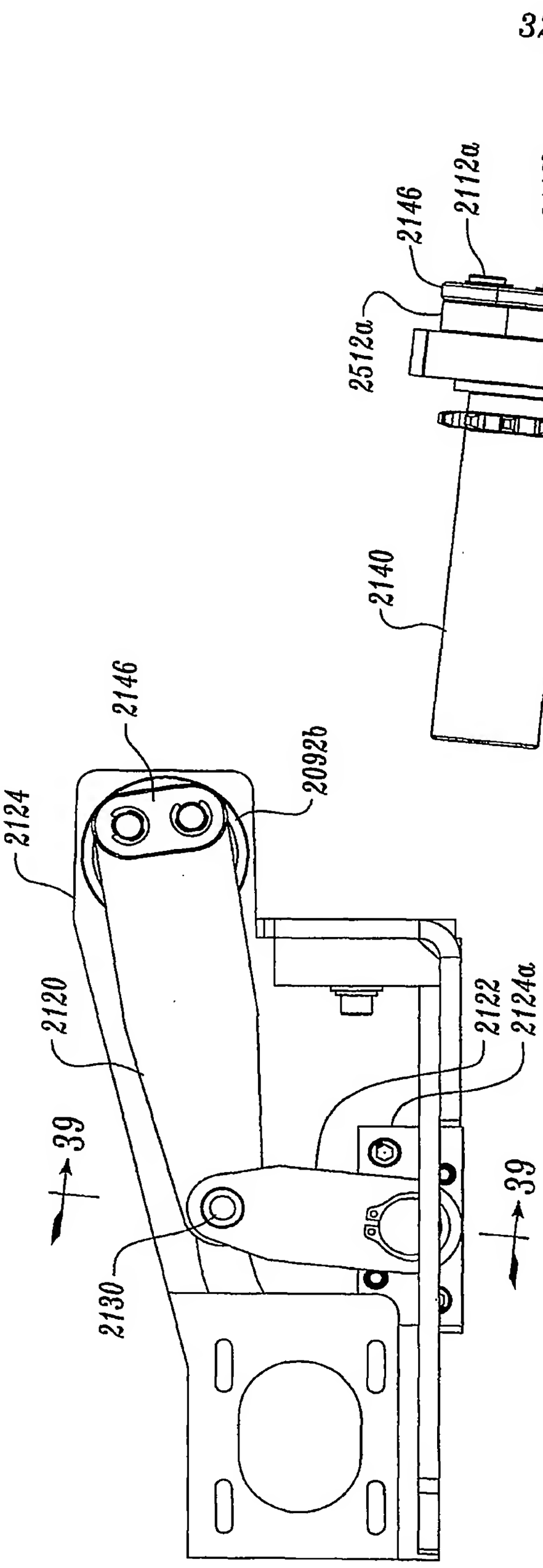

2146
2112a
2112b
2130
2122
2122a
2124a
2512a
2124b
2124
2140
2100
2146
2124
2092b
2120
2122
2124a
39
39
2130

Fig. 38

Fig. 39

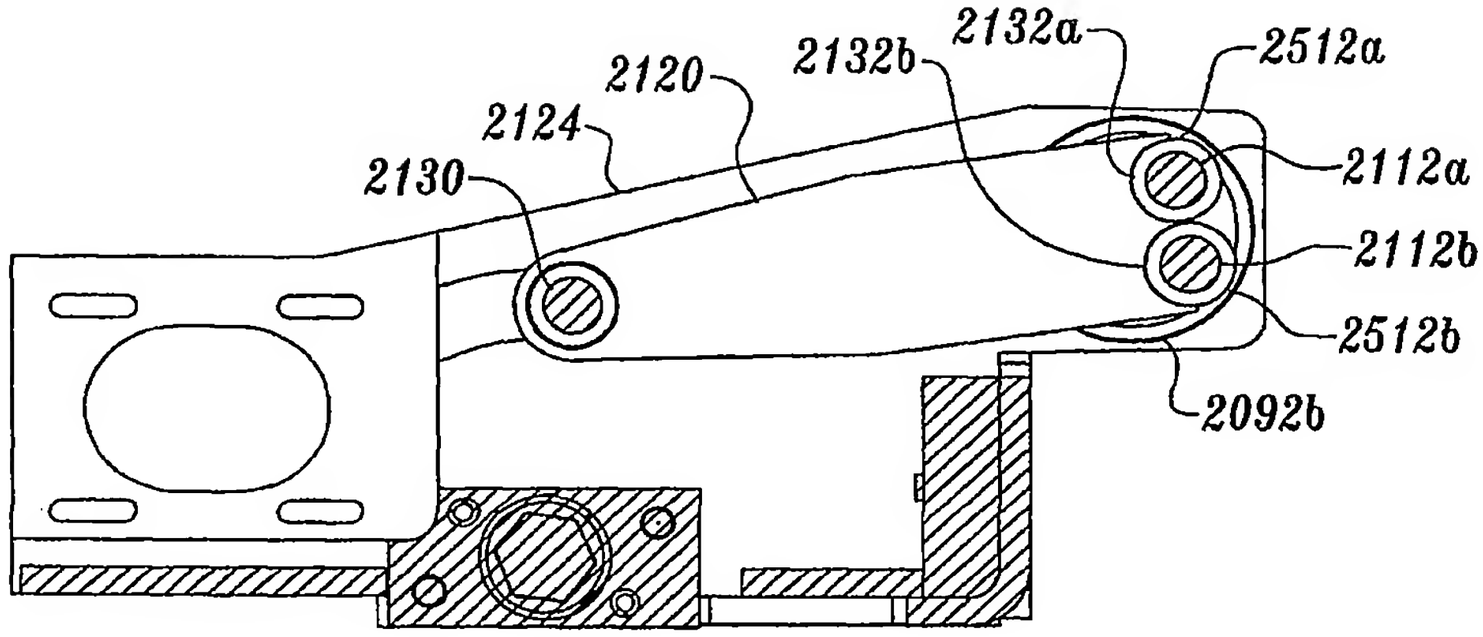

2132a
2512a
2120
2132b
2124
2130
2112a
2112b
2512b
2092b

Fig. 40

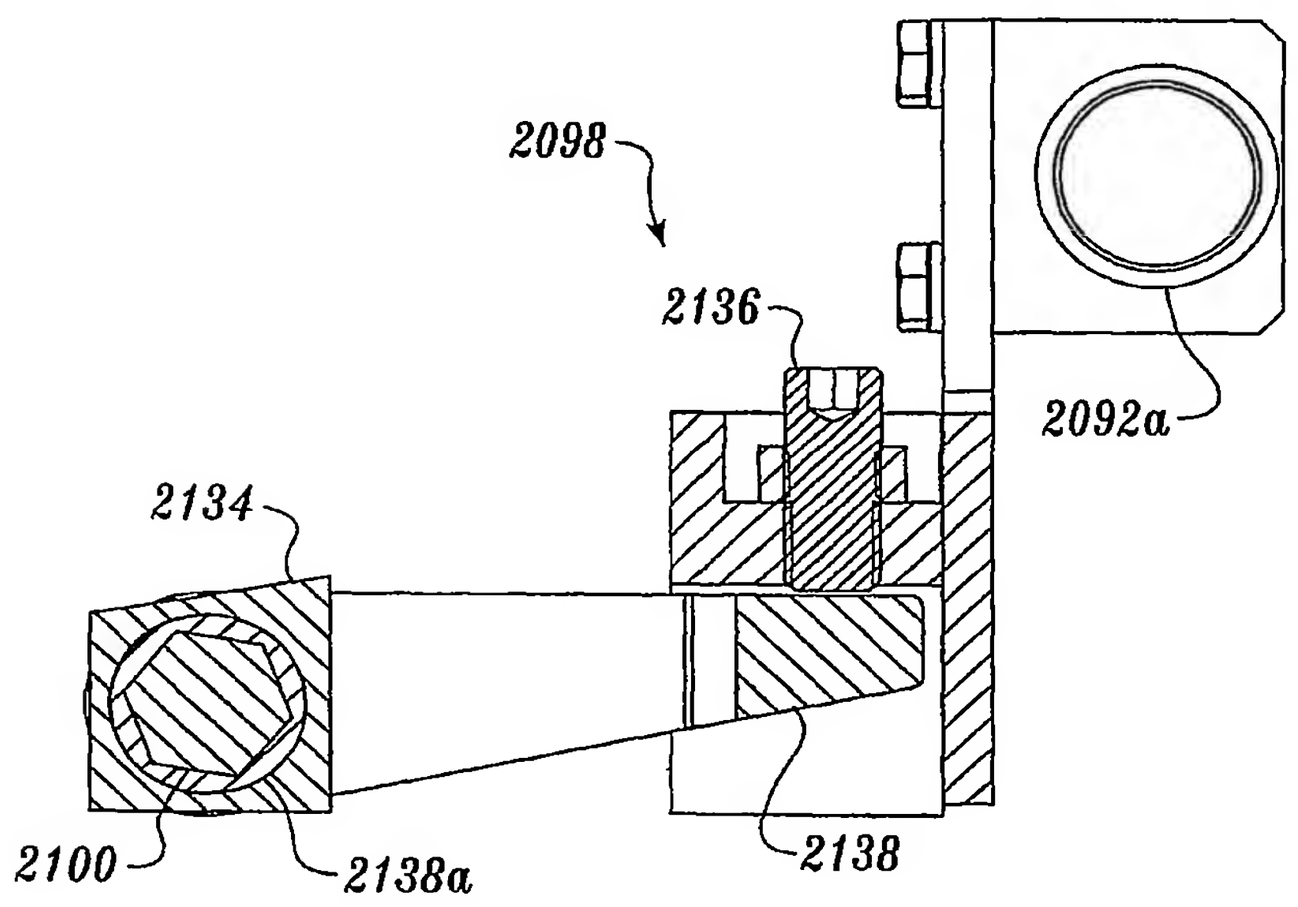

2098
2136
2092a
2134
2100
2138a
2138

Fig. 41

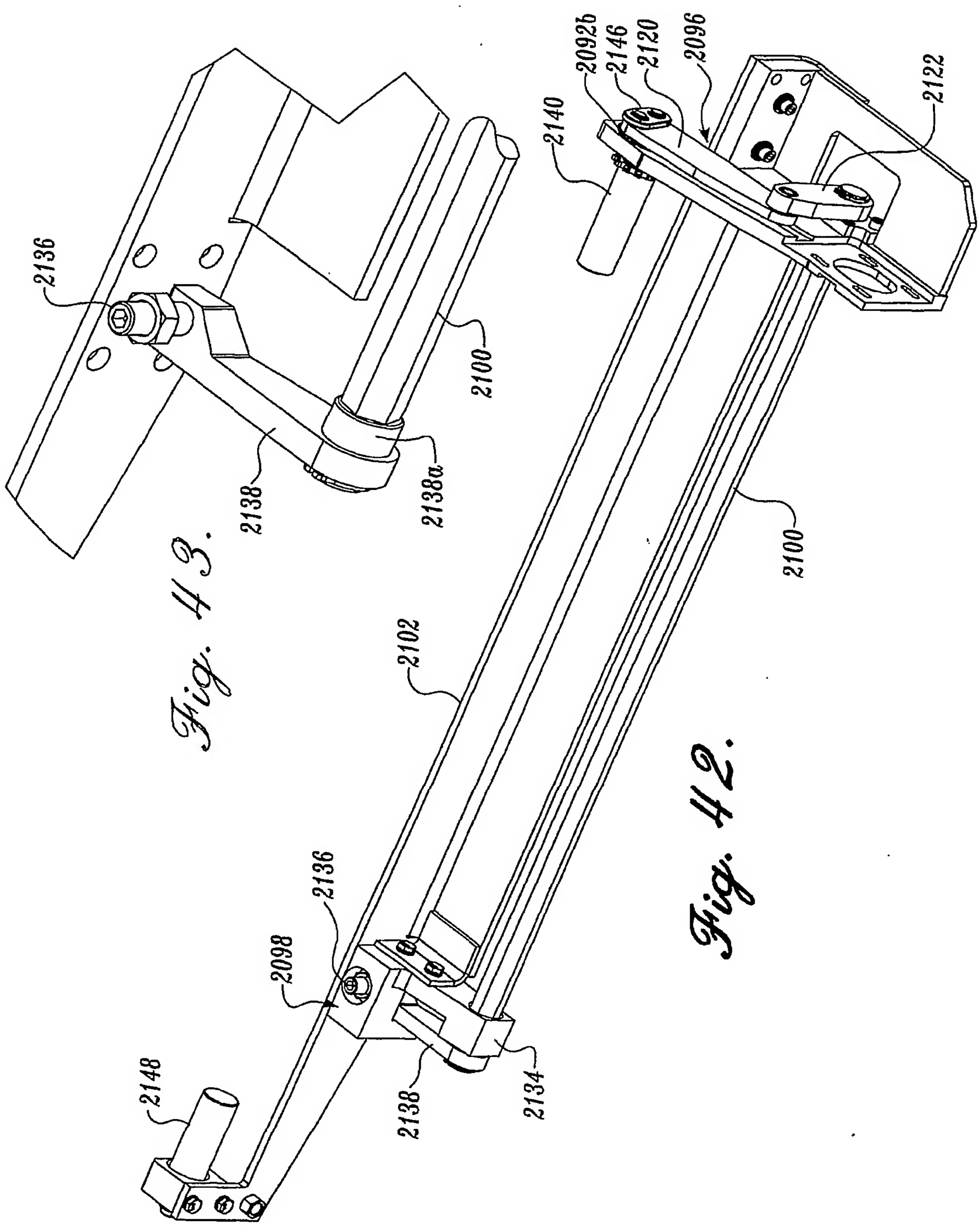

2140
20926
2146
2120
2096
2122
2136
2100
2138
2138a
2102
2100
2136
2098
2148
2138
2134

Fig. 43.

Fig. 42.

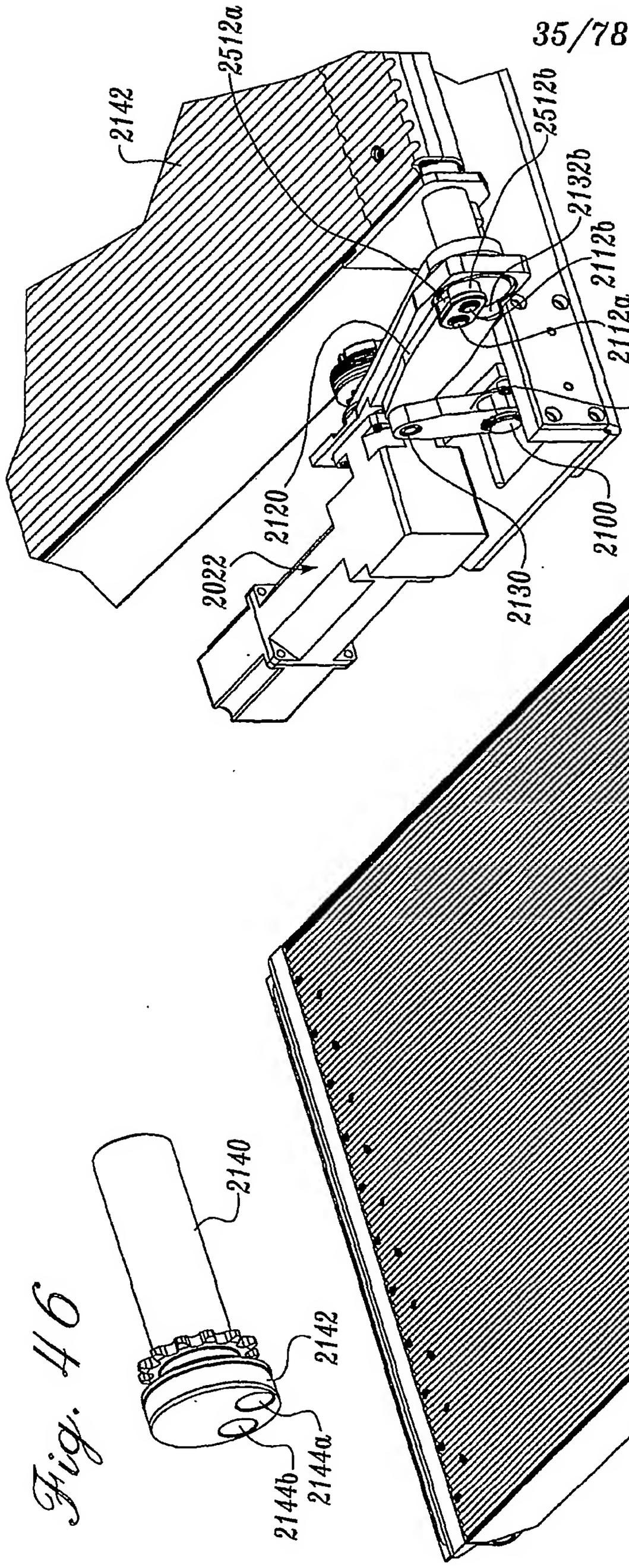


Fig. 45

Fig. 44

Fig. 46

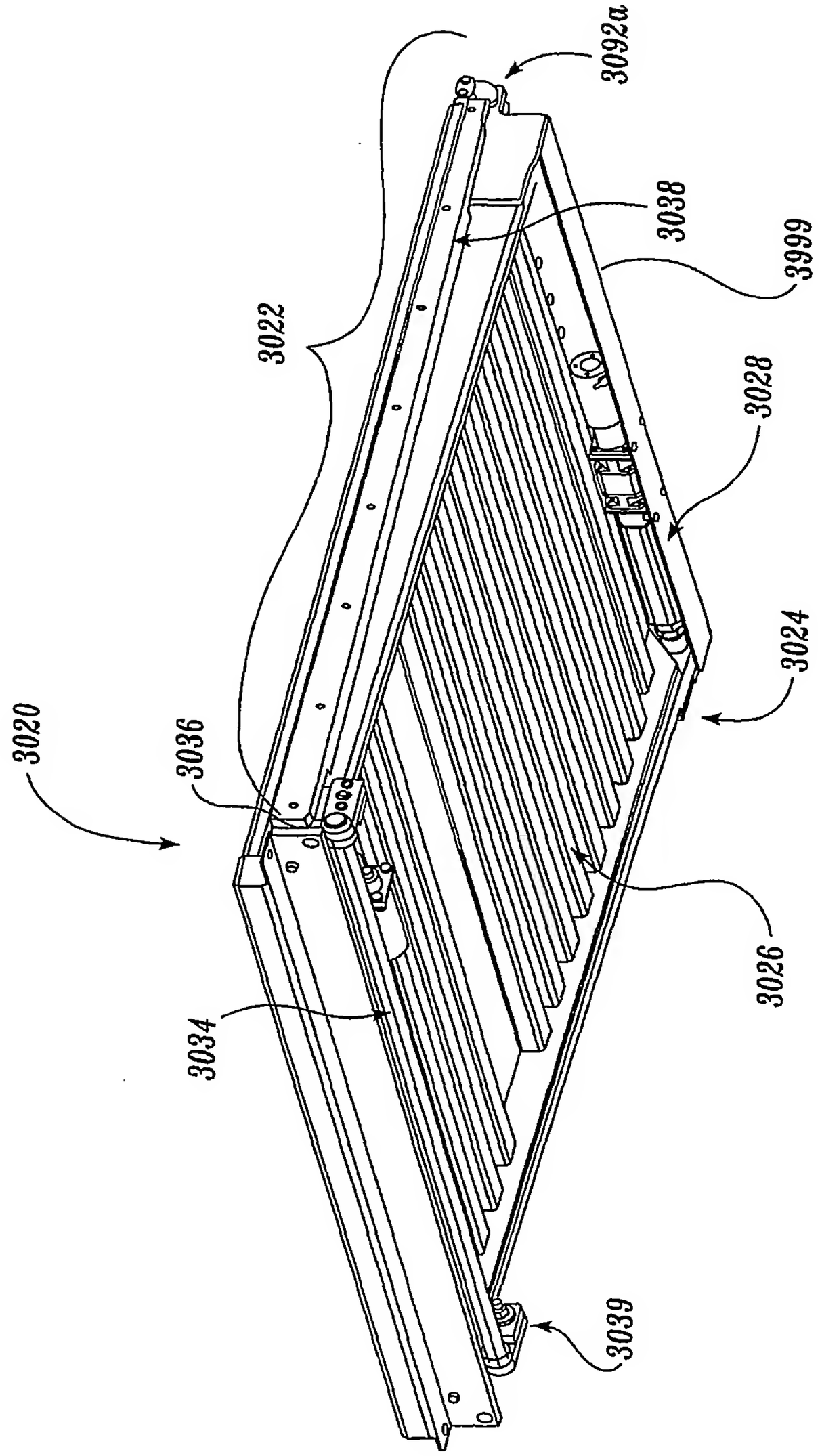


Fig. 47

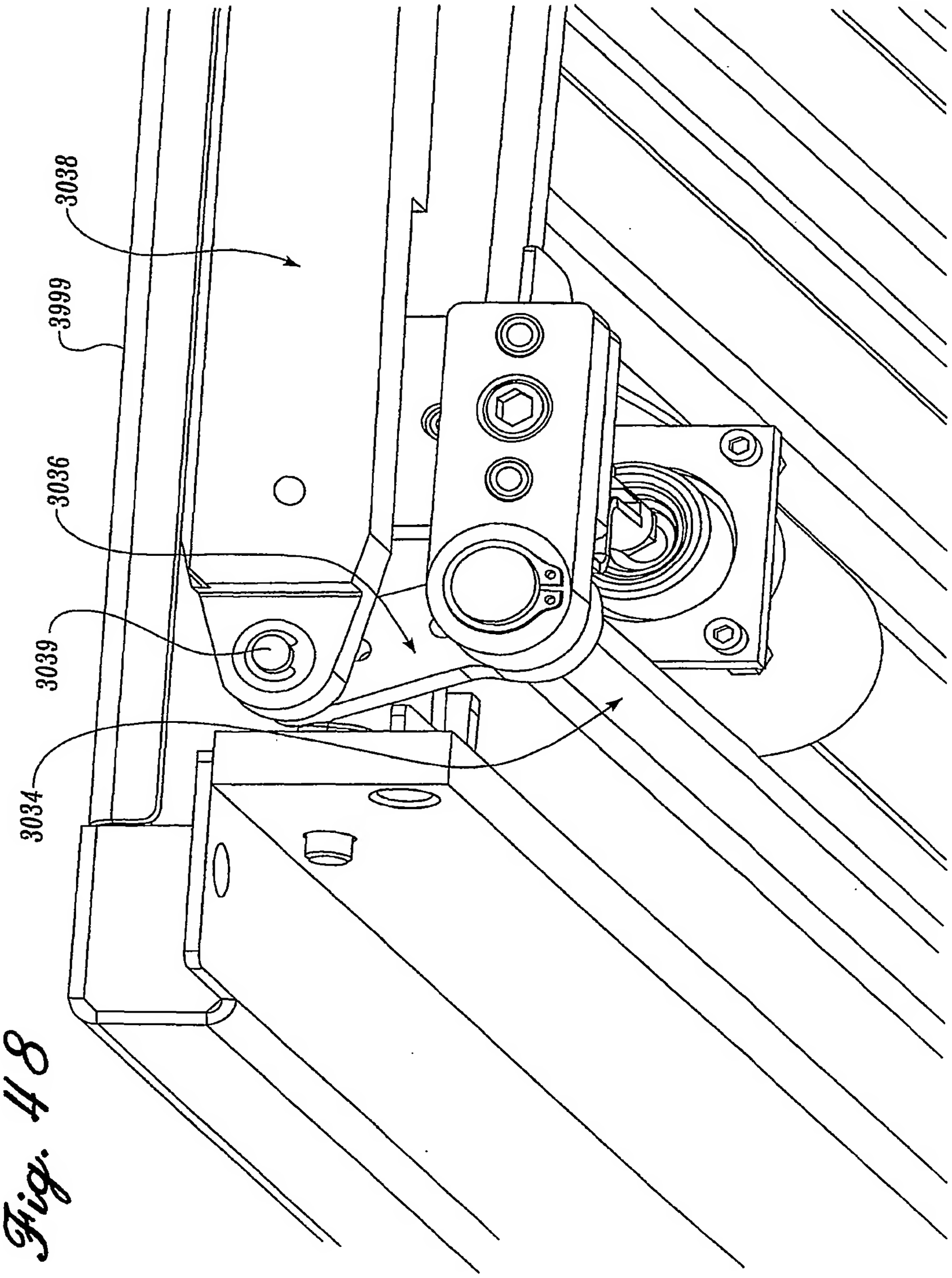


Fig. 118

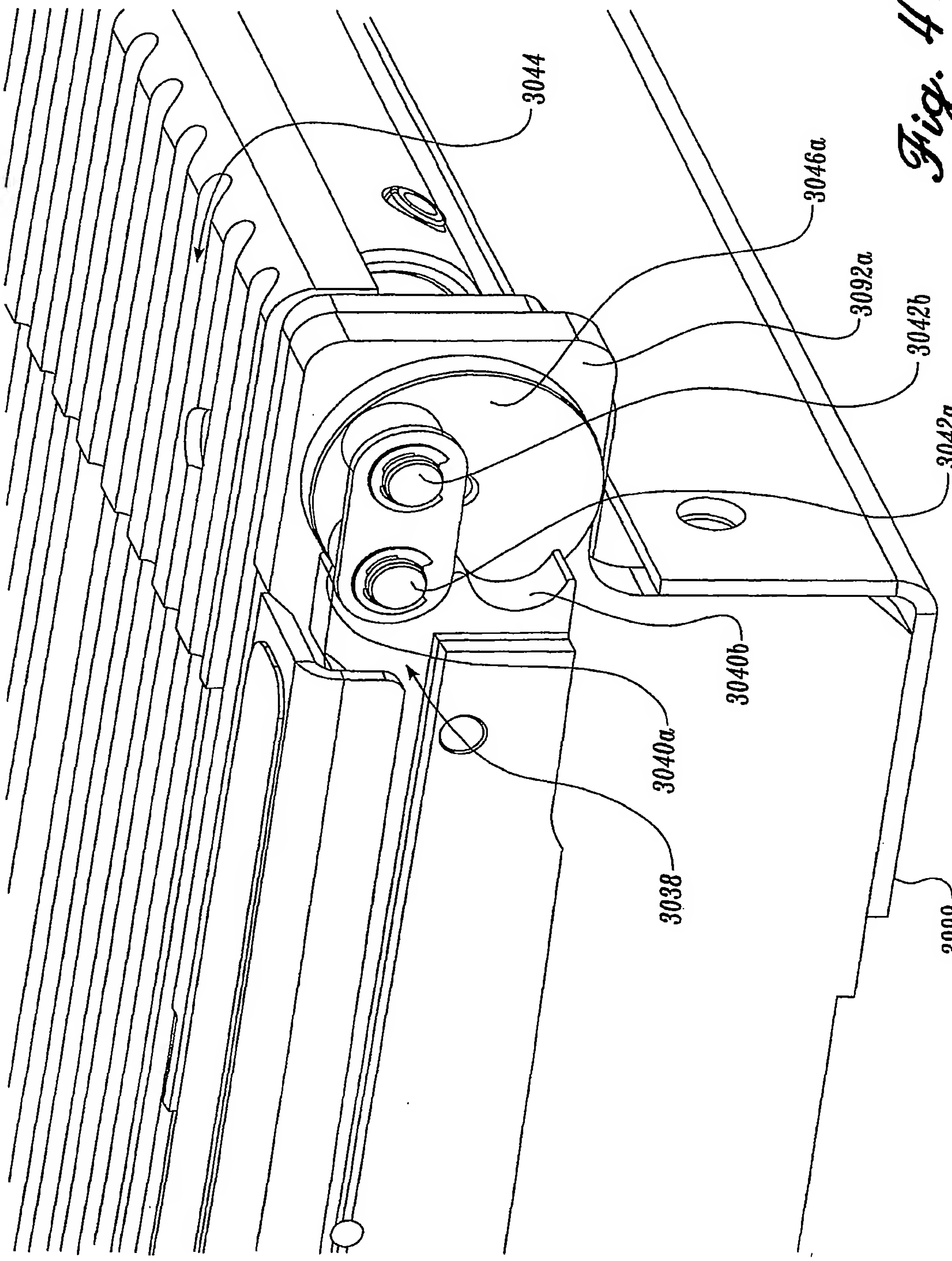


Fig. 49

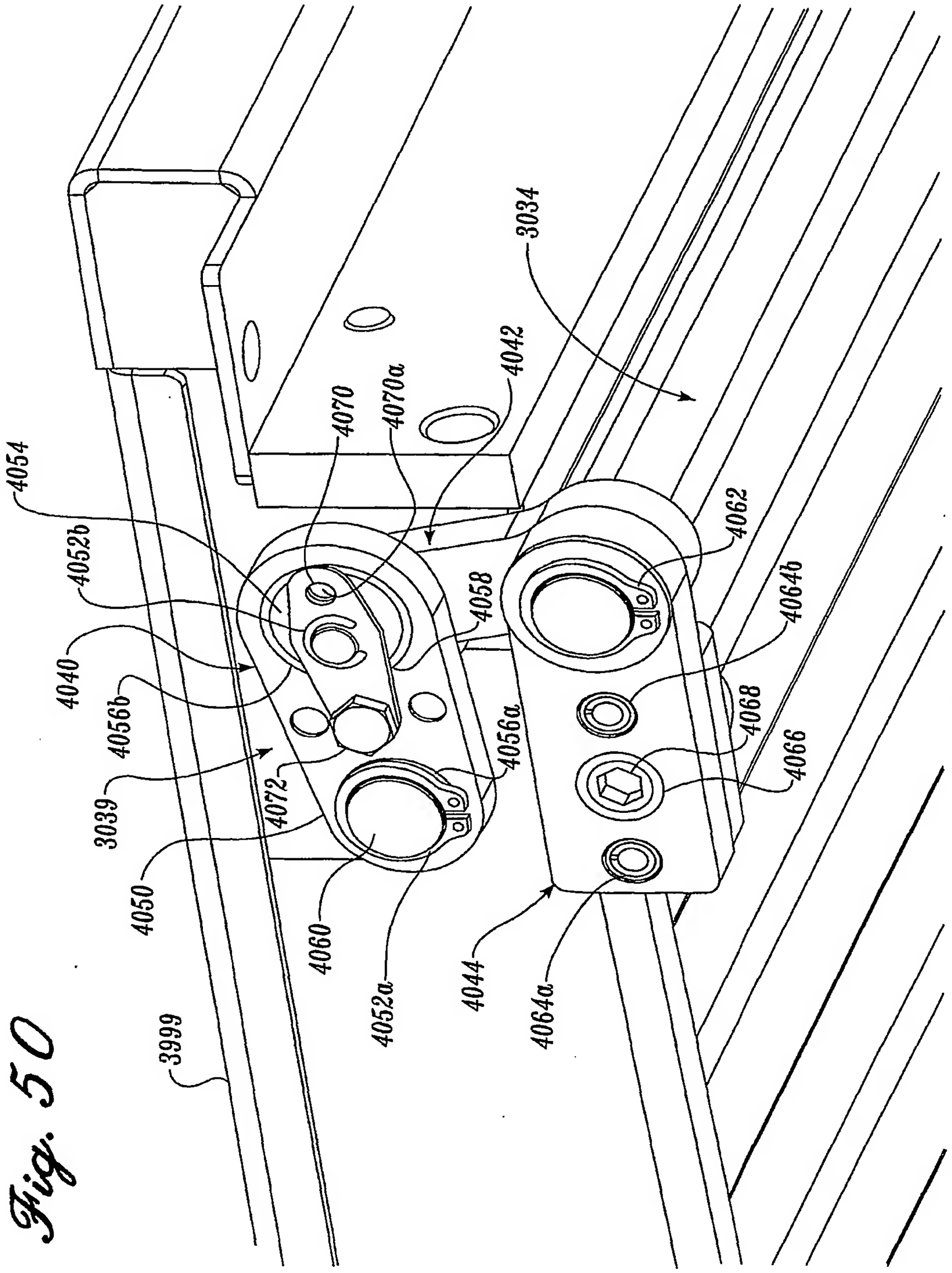

4054
4052b
4040
4056b
3039
4072
4050
4060
3999
4052a
4044
4064a
4070
4070a
4042
4058
4056a
3034
4062
4064b
4068
4066

Fig. 50

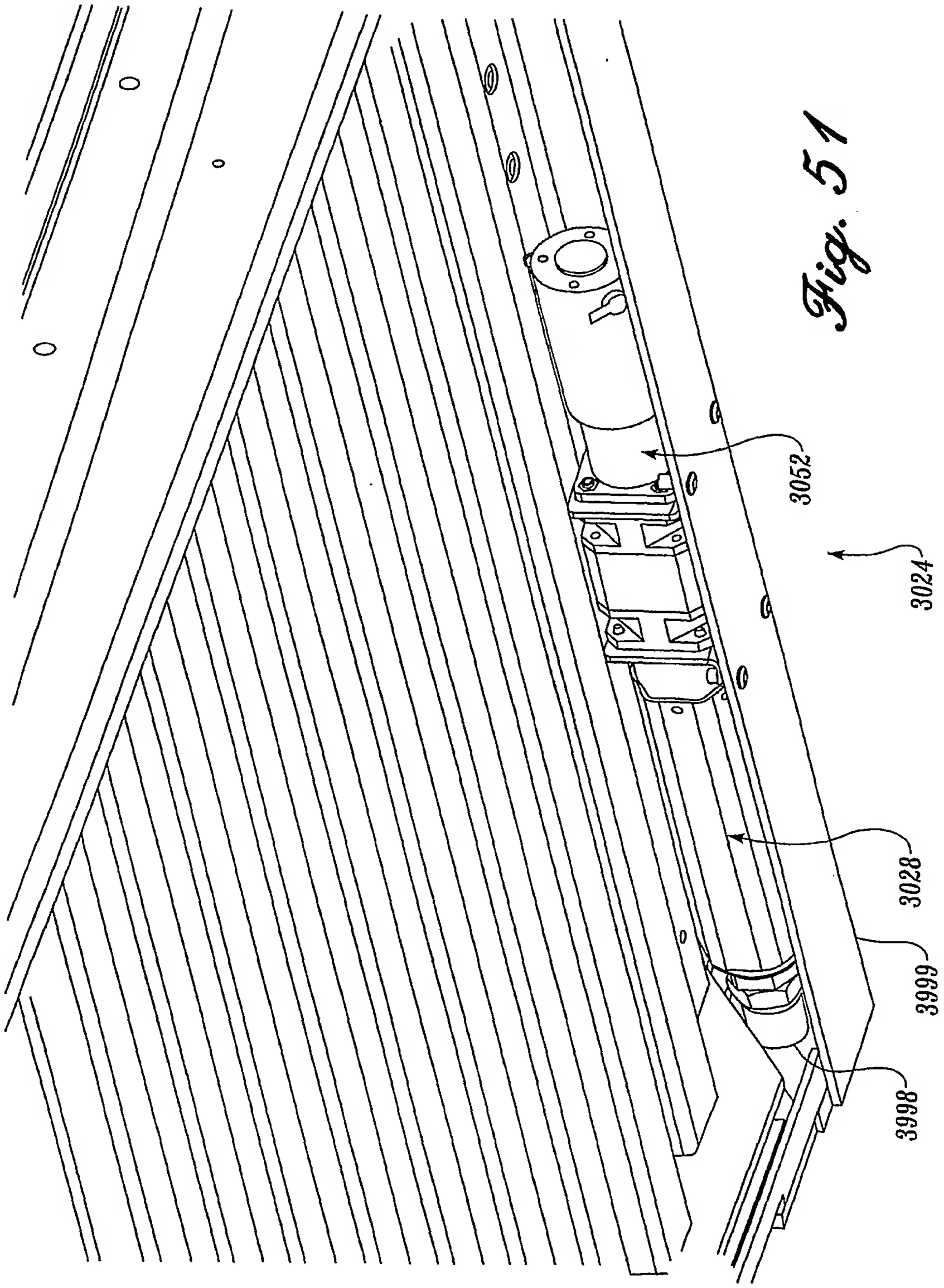


Fig. 51

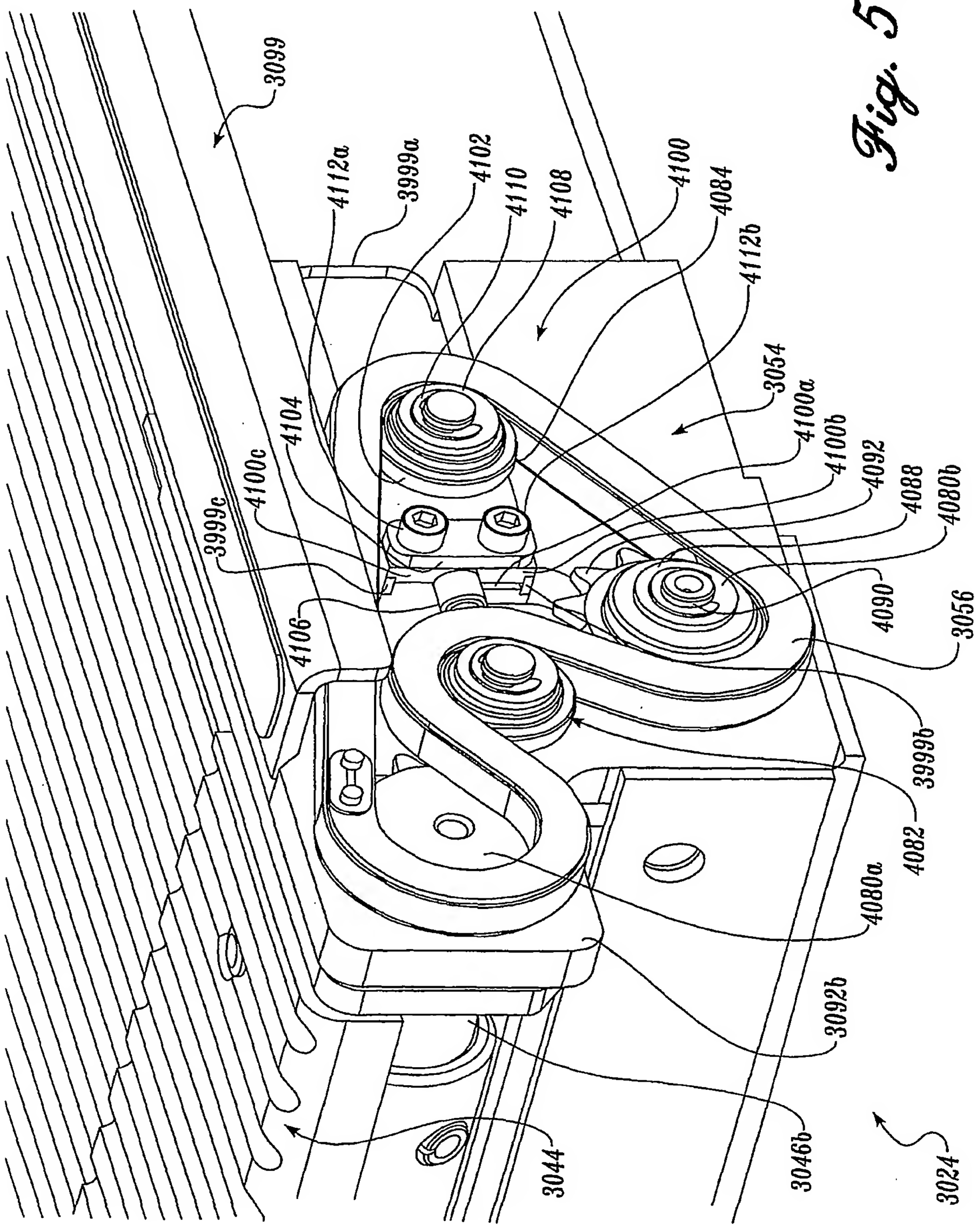

3099
4112a
3999a
4102
4110
4108
4100
4084
4112b
3054
4100a
4100b
4092
4088
4080b
4090
3056
3999b
4082
4080a
3092b
3046b
3024
3044
4106
4104
4100c
3999c

Fig. 52

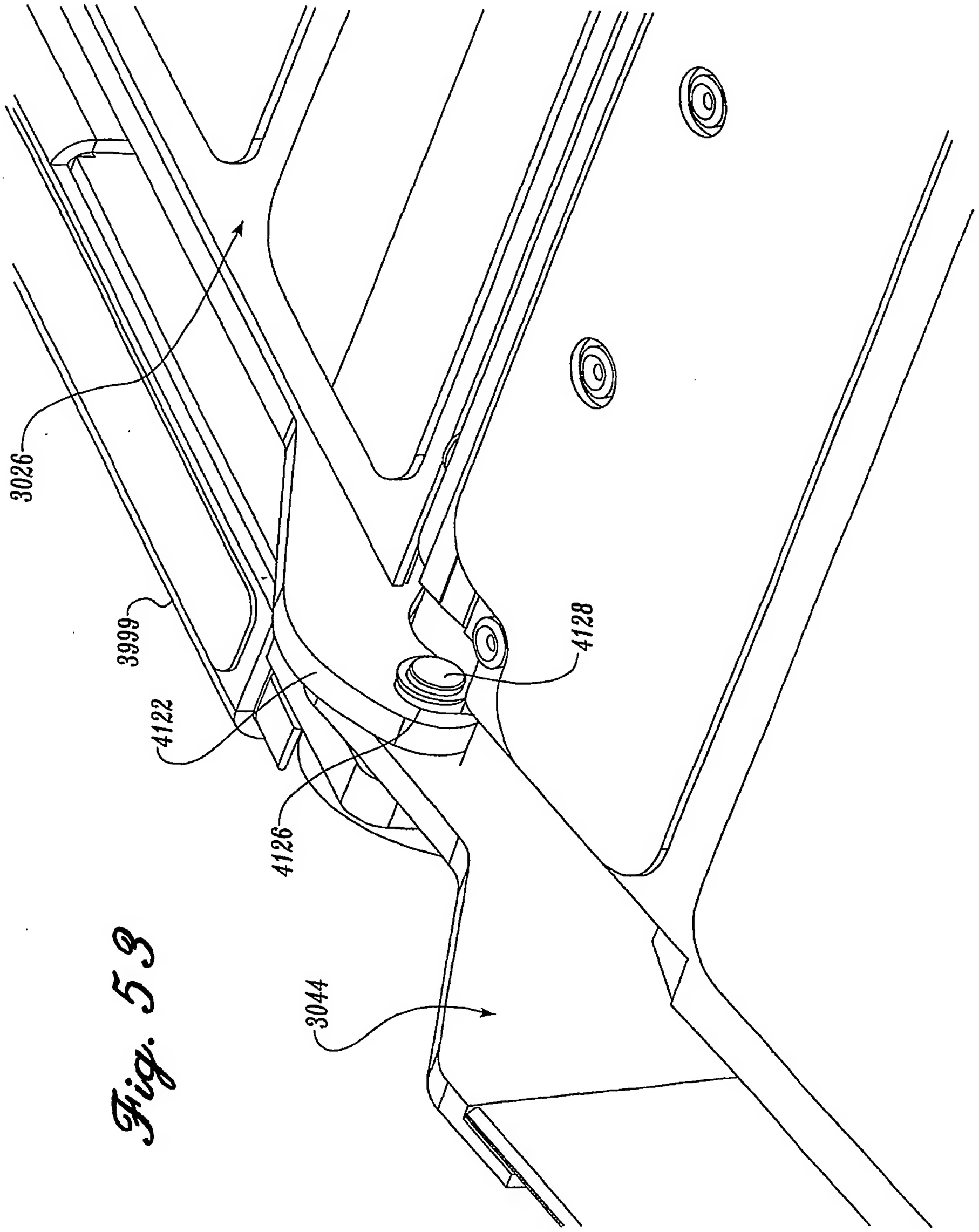


Fig. 53

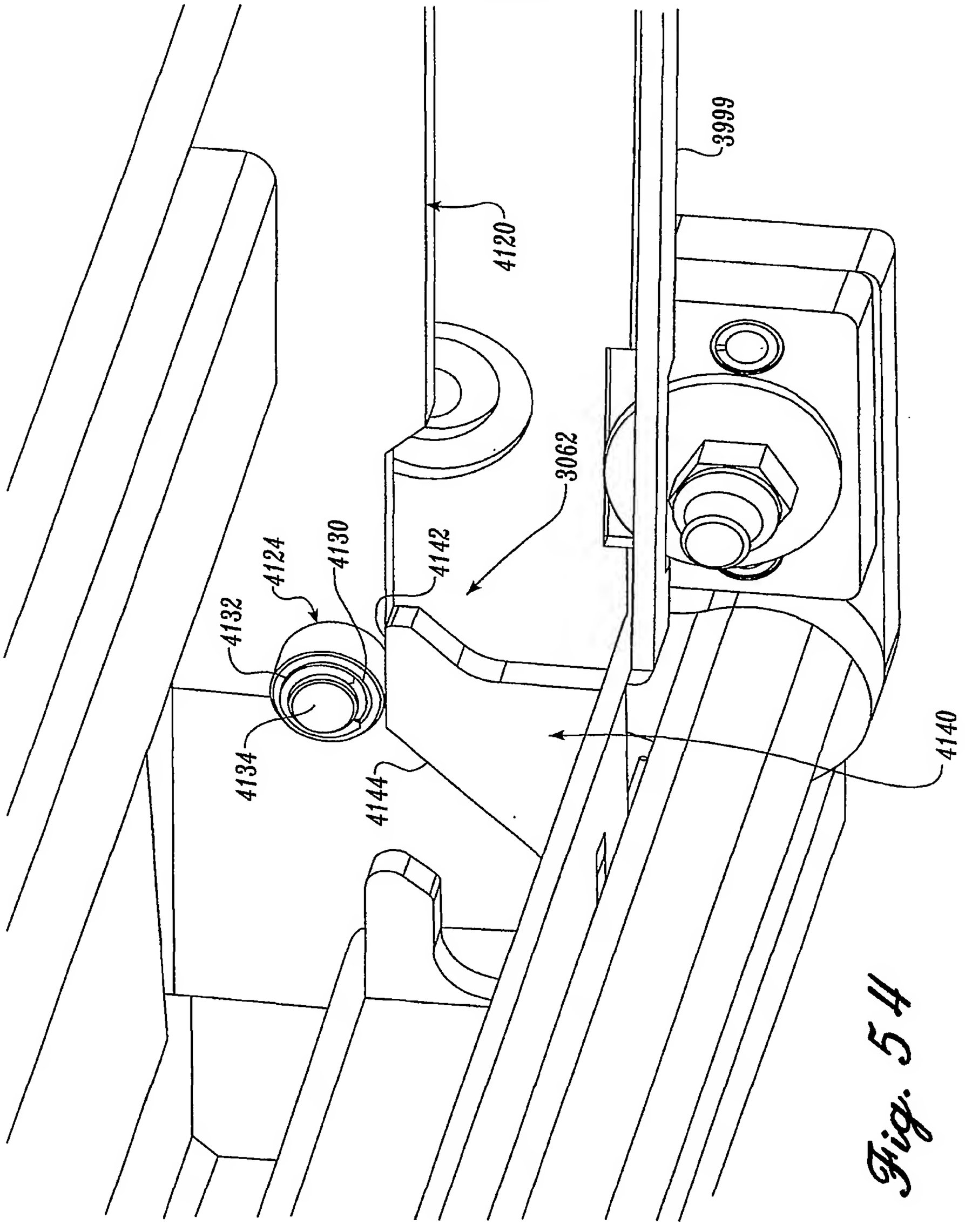


Fig. 54

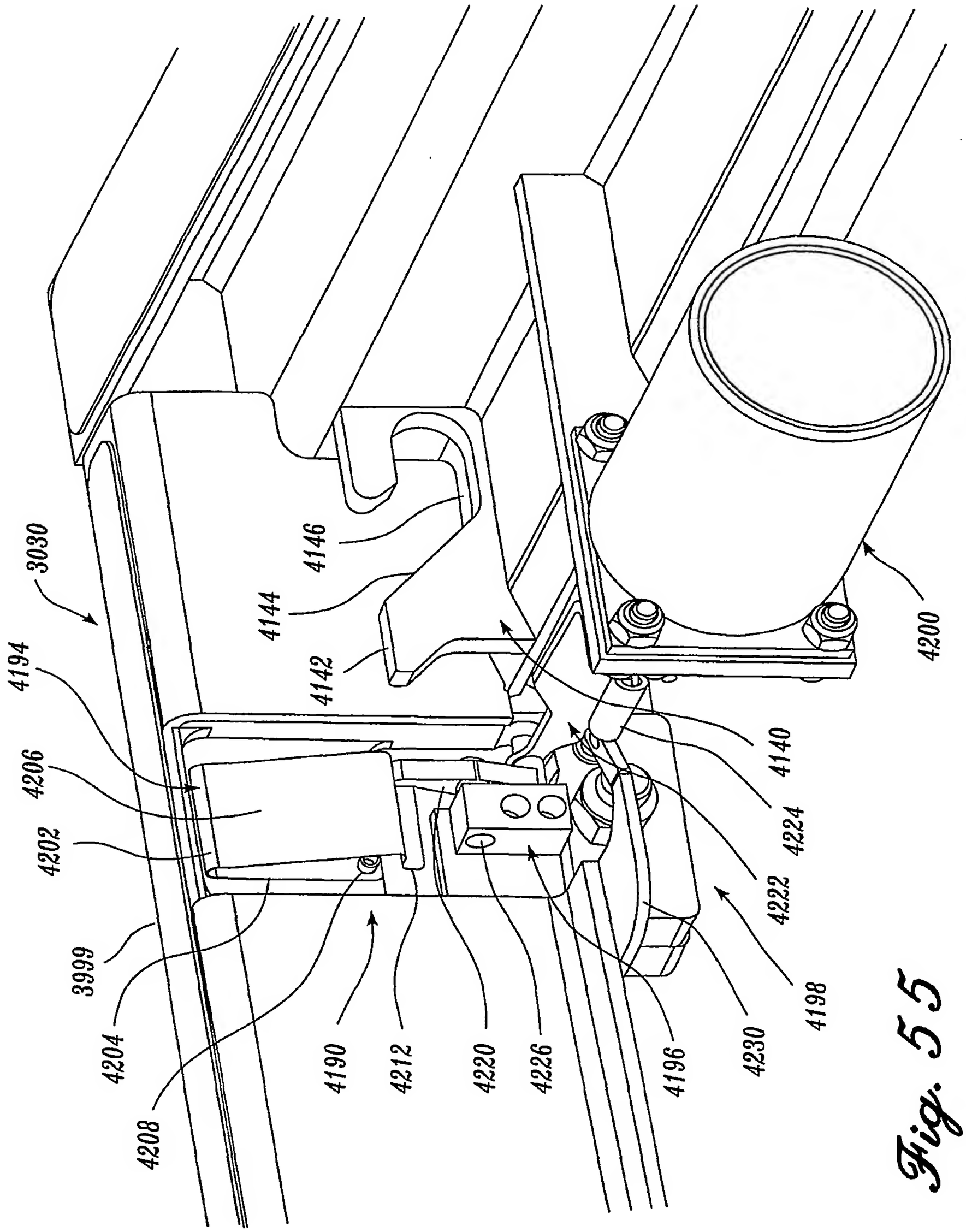

3030
4194
4206
4202
3999
4204
4208
4144
4146
4142
4190
4212
4220
4226
4196
4230
4198
4222
4224
4140
4200

Fig. 55

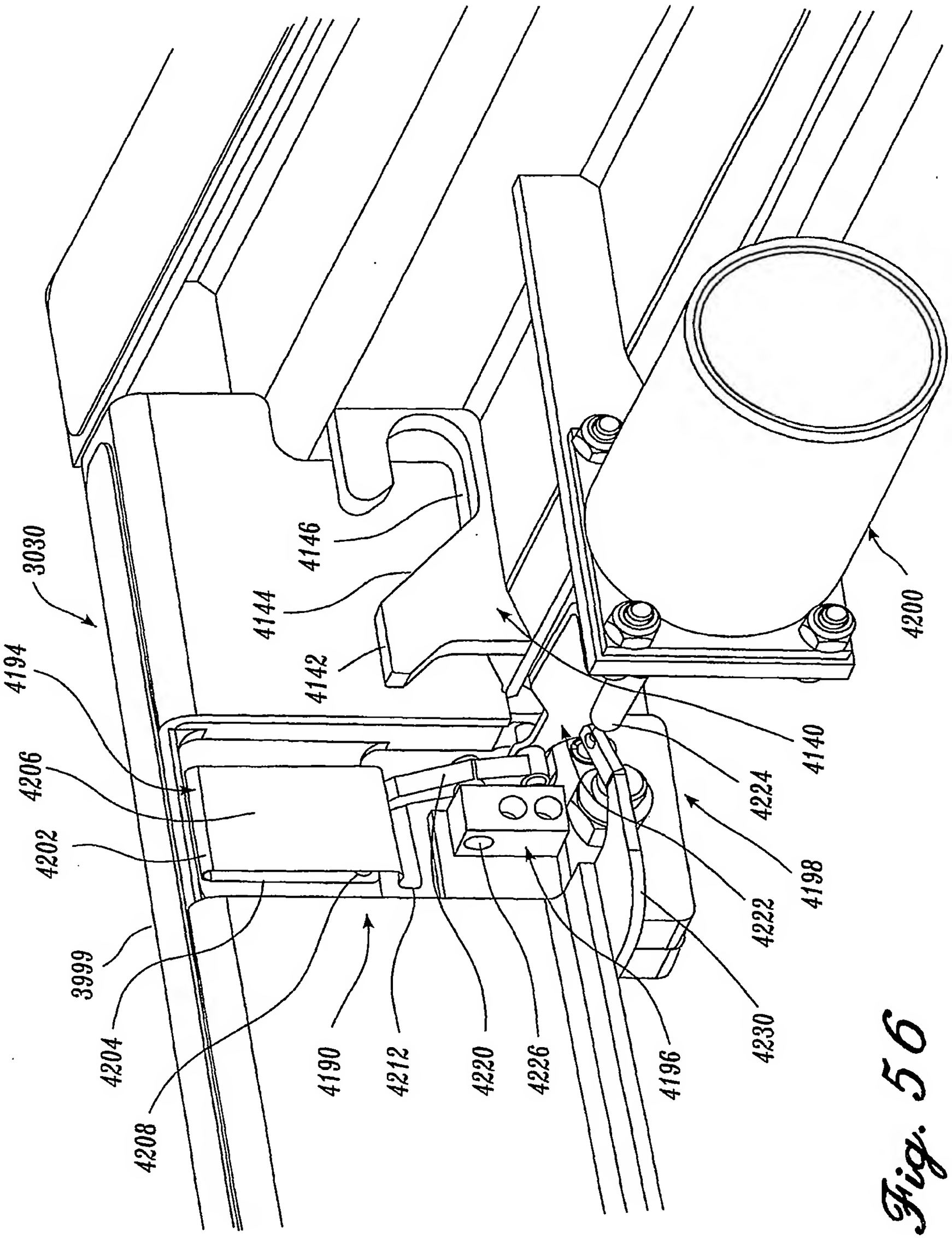

3030
4194
4206
4202
3999
4204
4208
4144
4146
4142
4190
4212
4220
4226
4196
4230
4222
4224
4198
4140
4200

Fig. 56

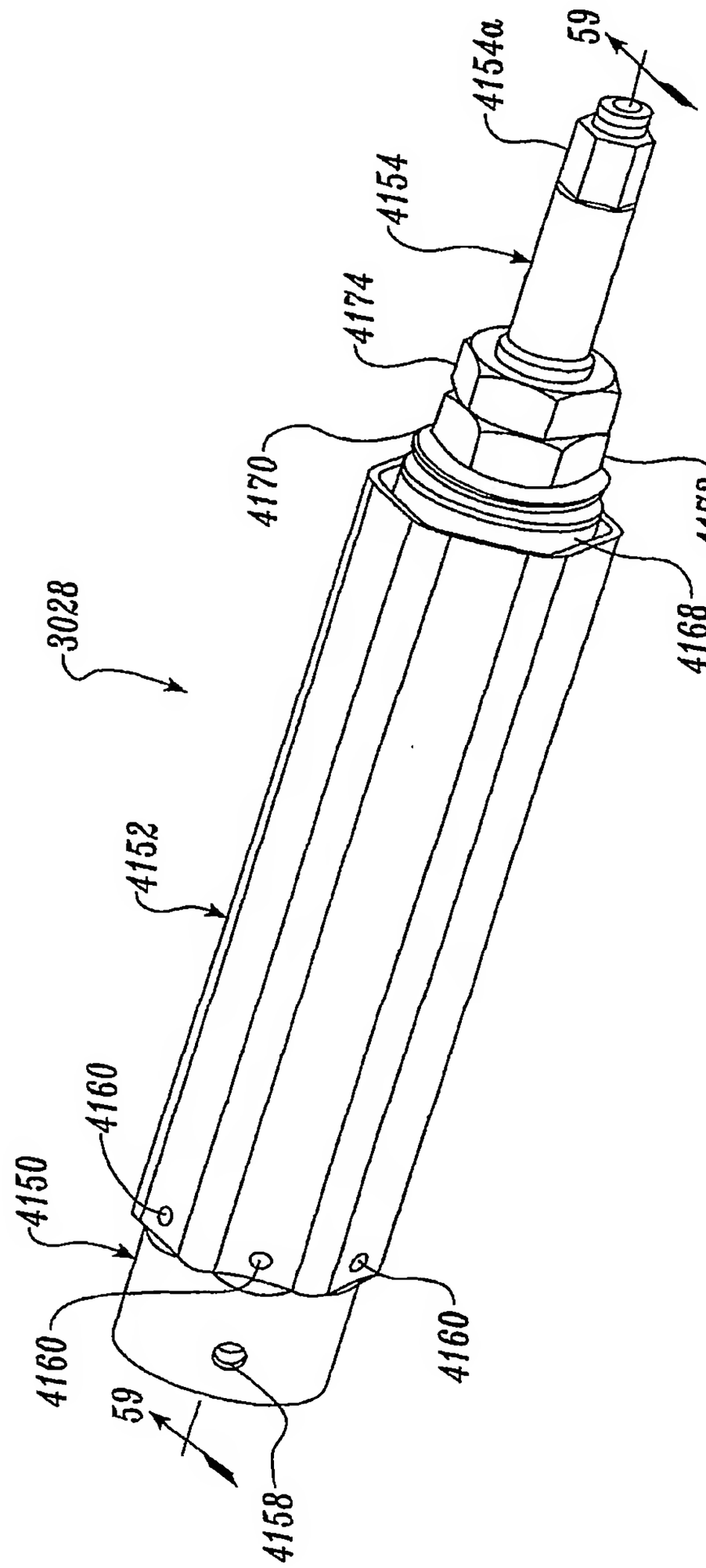

59
4154a
4154
4174
4170
4172
4168
3028
4152
4160
4150
4160
4160
59
4158

Fig. 57

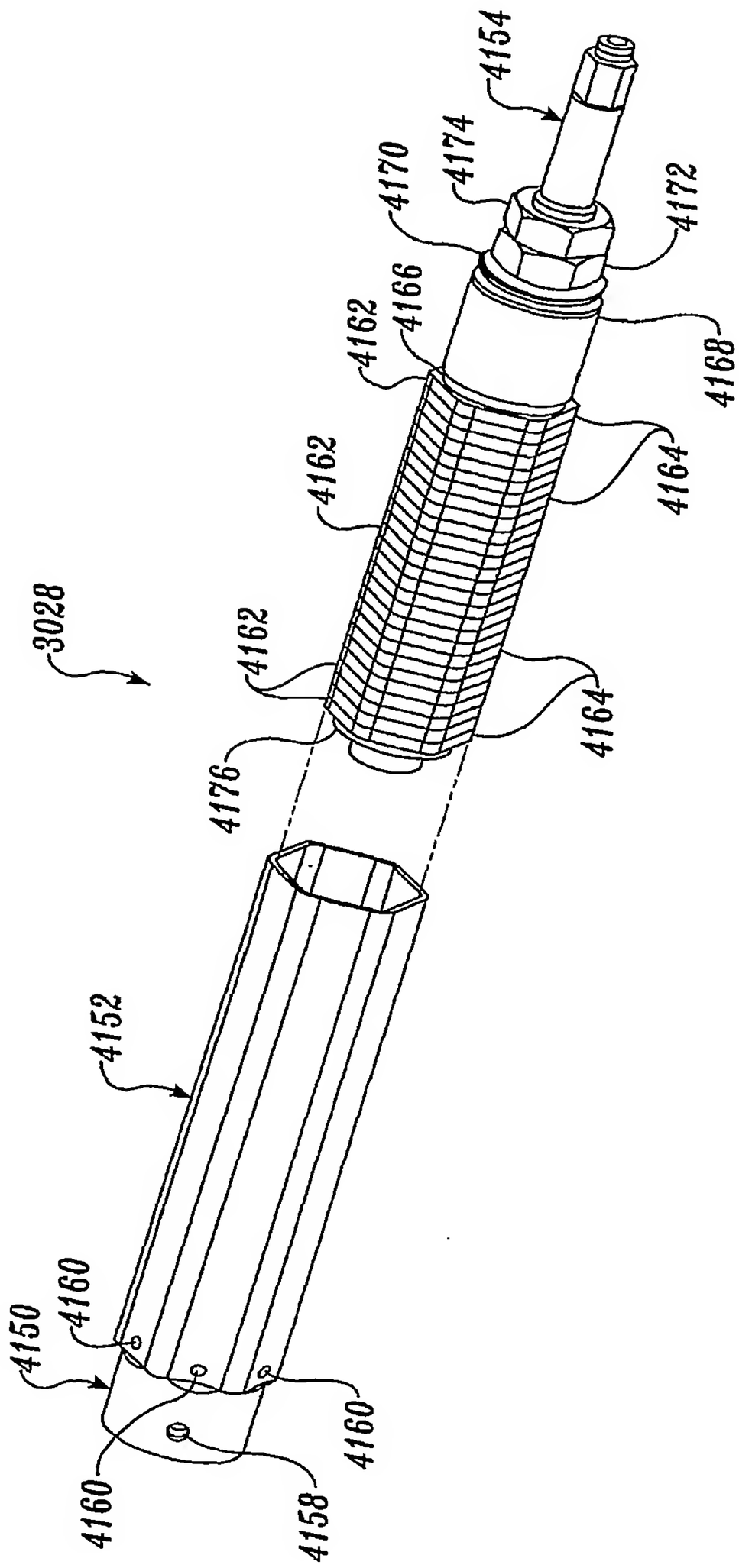

3028
4152
4154
4150
4160
4160
4160
4158
4176
4162
4162
4162
4164
4164
4166
4168
4170
4172
4174

Fig. 58

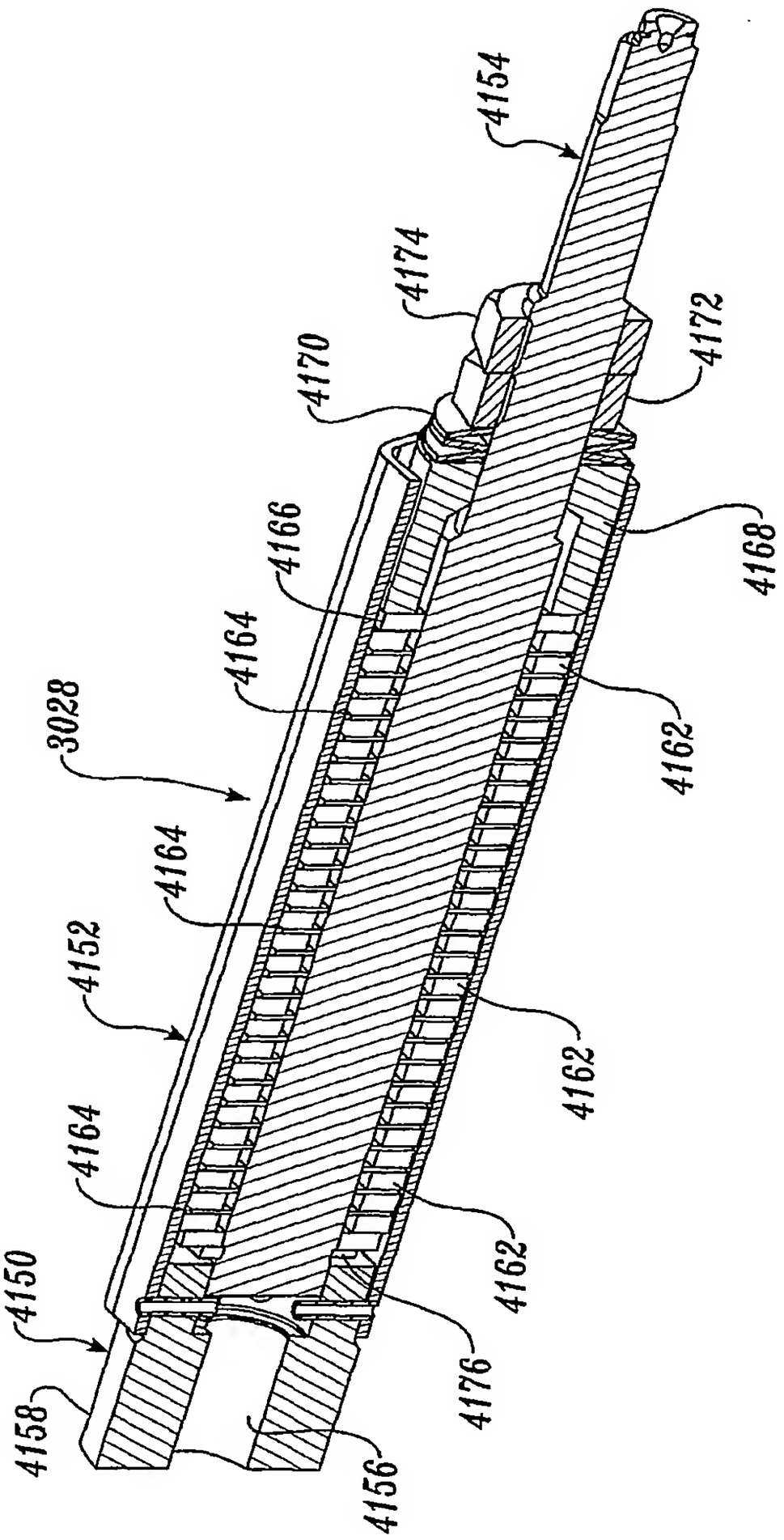

4154
4174
4172
4170
4166
4168
4164
3028
4164
4162
4152
4164
4162
4150
4158
4156
4176

Fig. 59

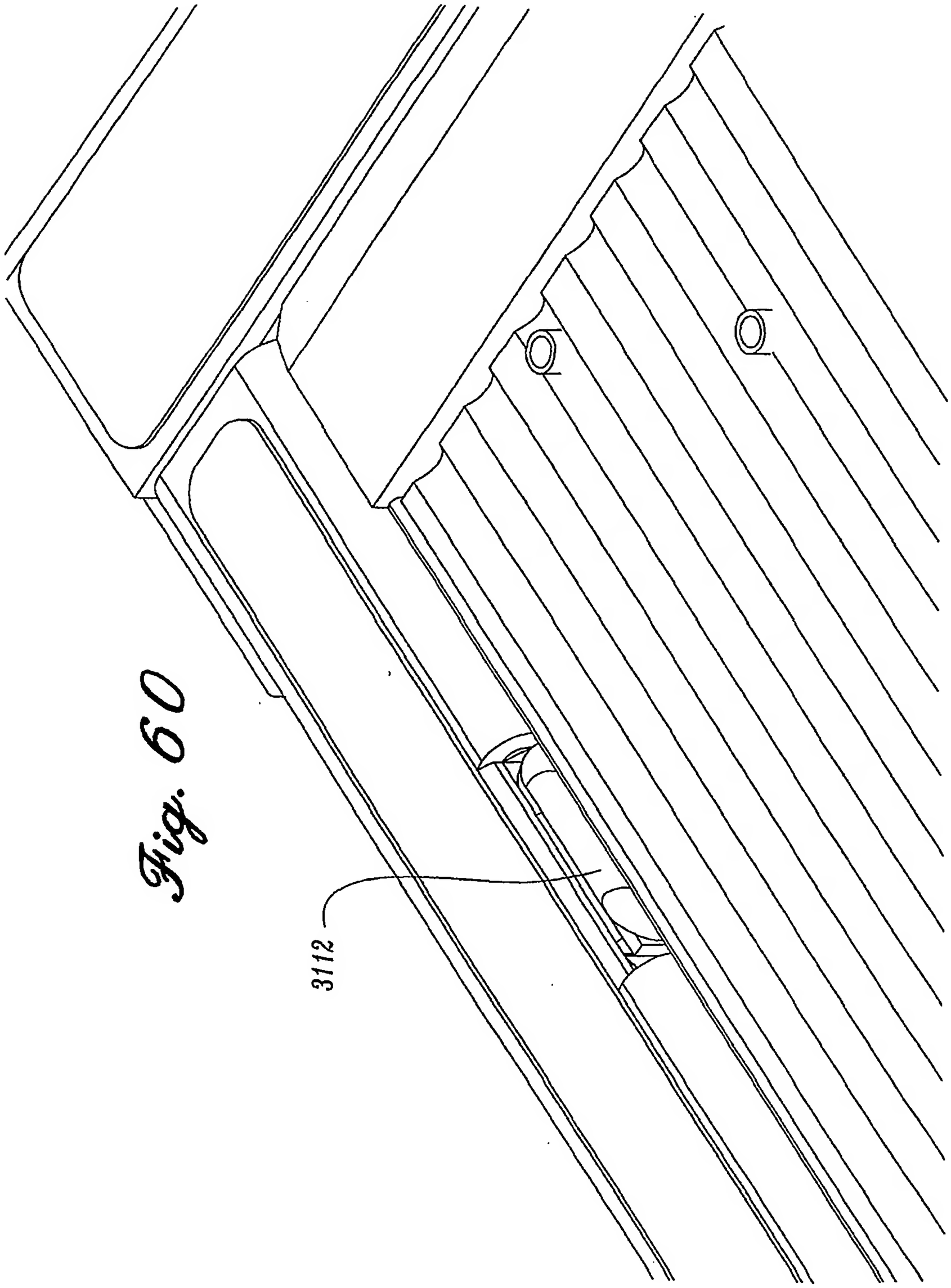


Fig. 60

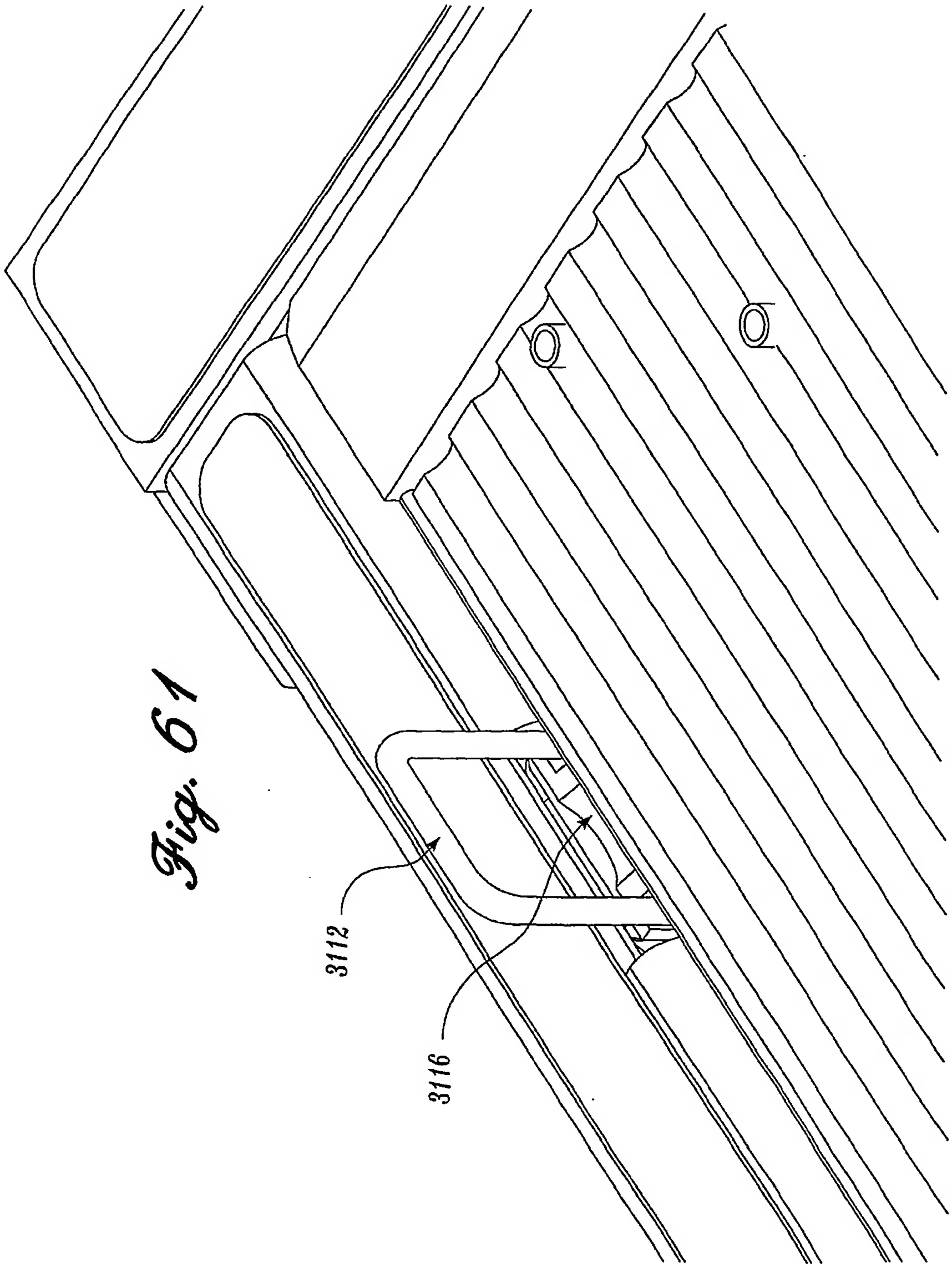


Fig. 61

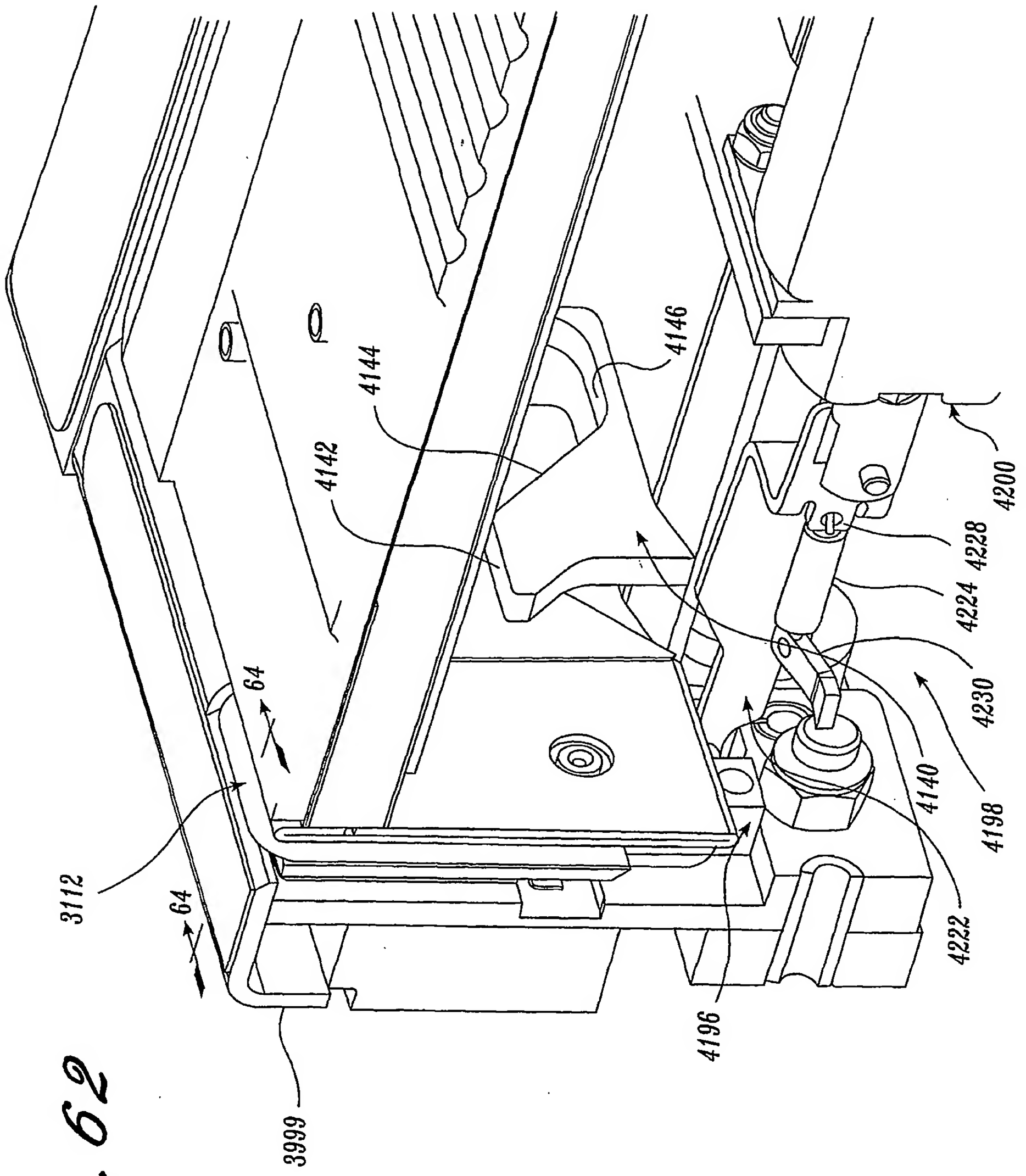

3112
64
64
3999
4142
4144
4146
4196
4198
4140
4230
4224
4228
4200
4222

Fig. 62

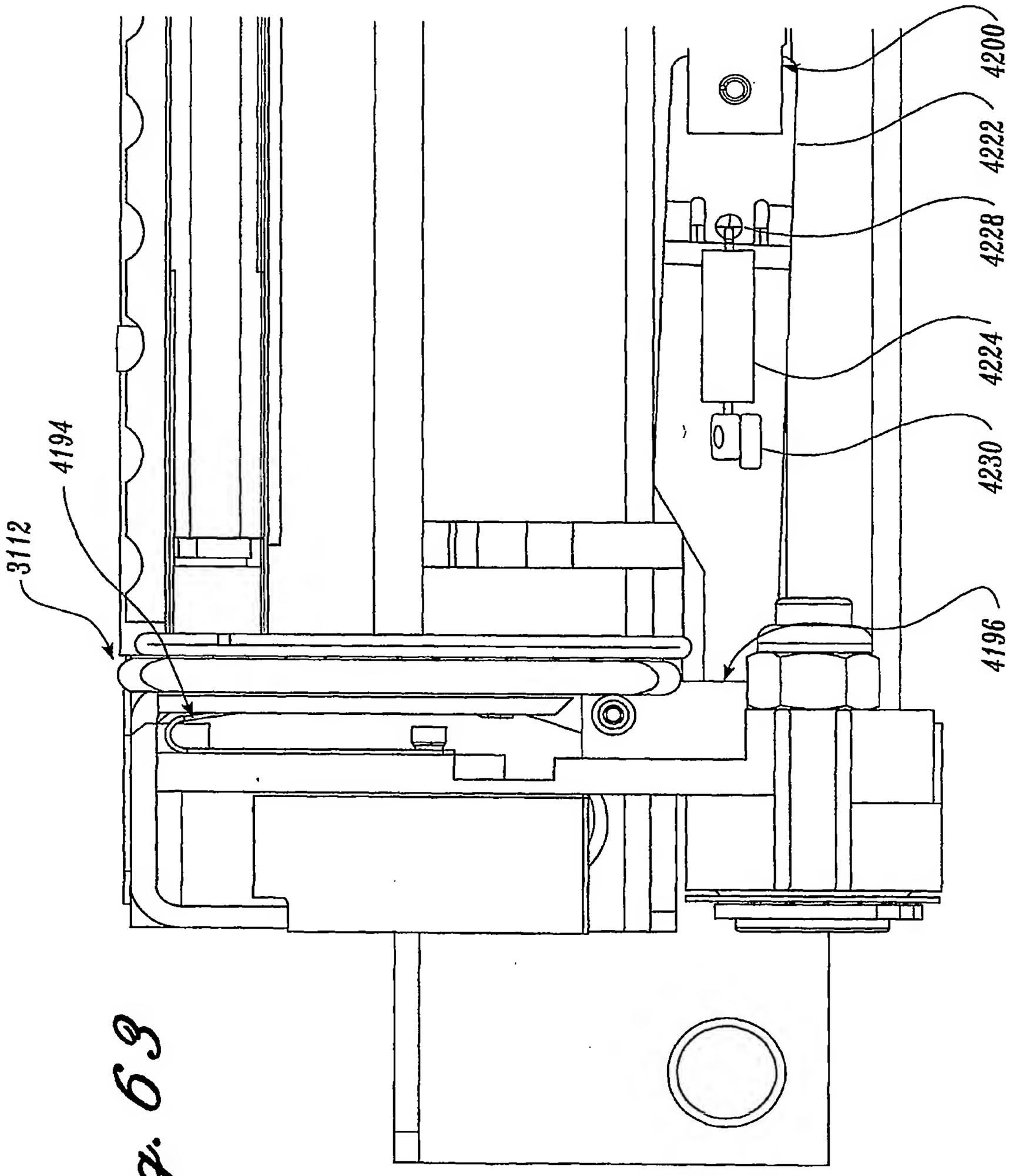


Fig. 63

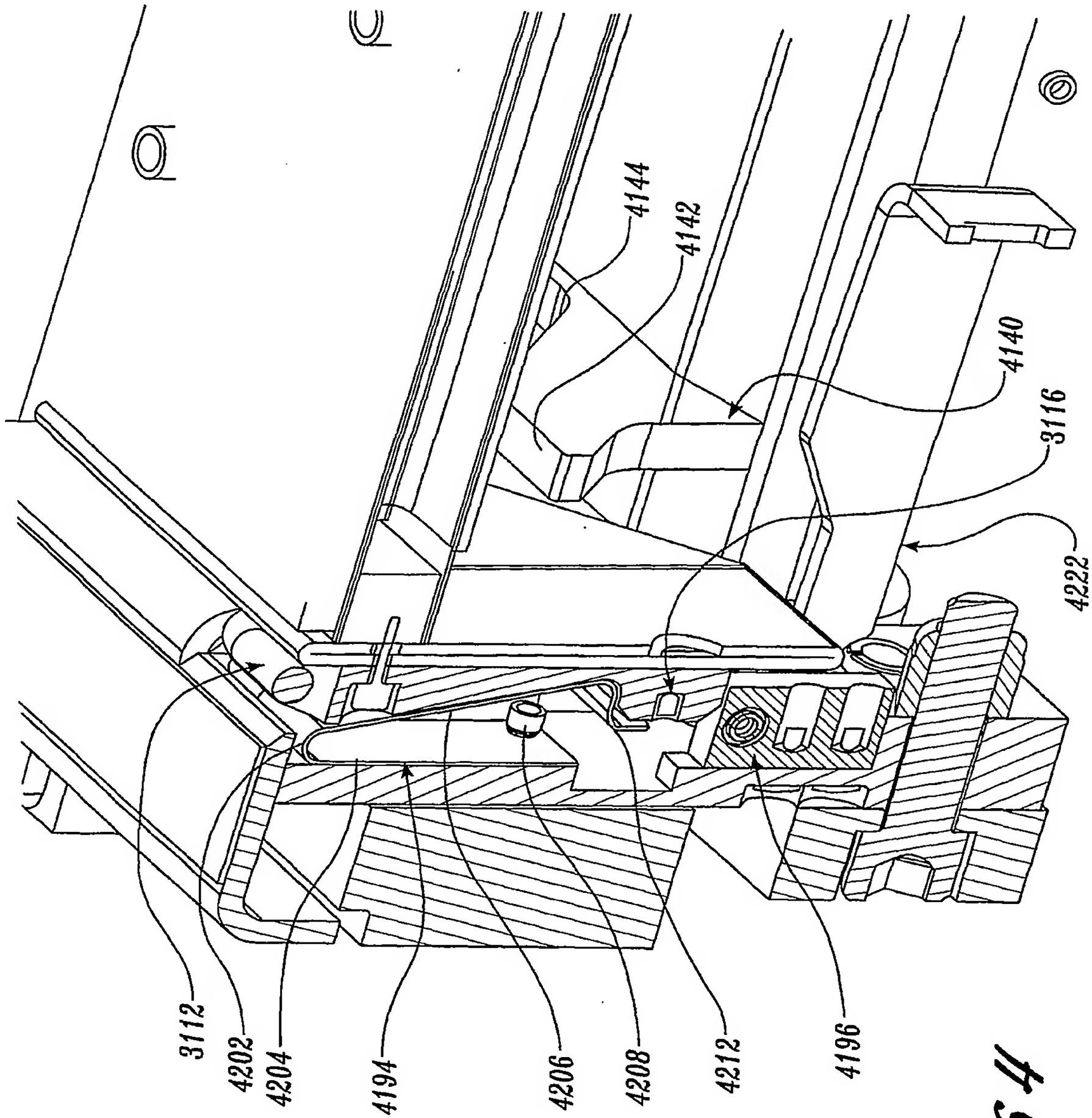

4144
4142
4140
3116
4222
3112
4202
4204
4194
4206
4208
4212
4196

Fig. 64

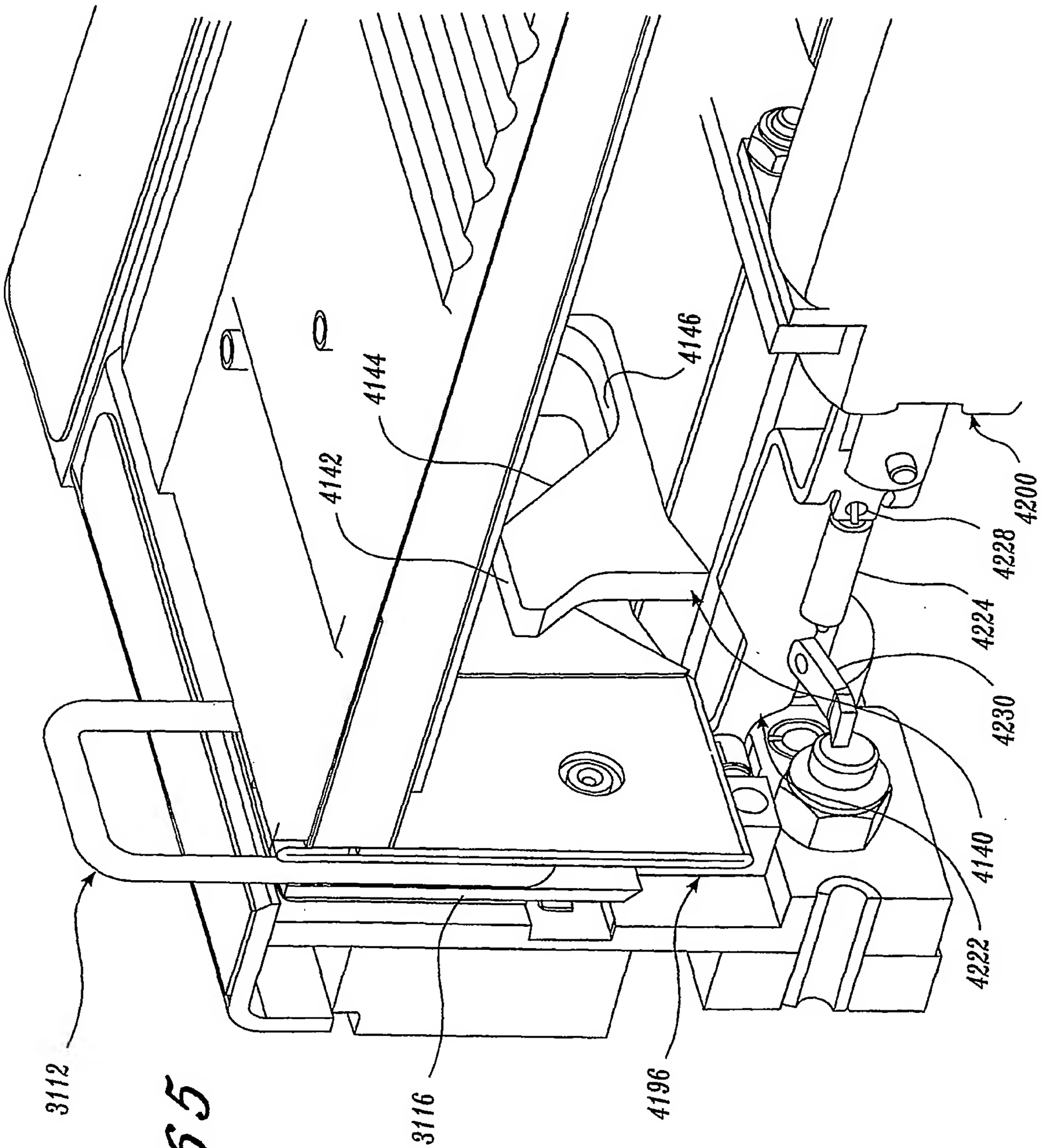


Fig. 65

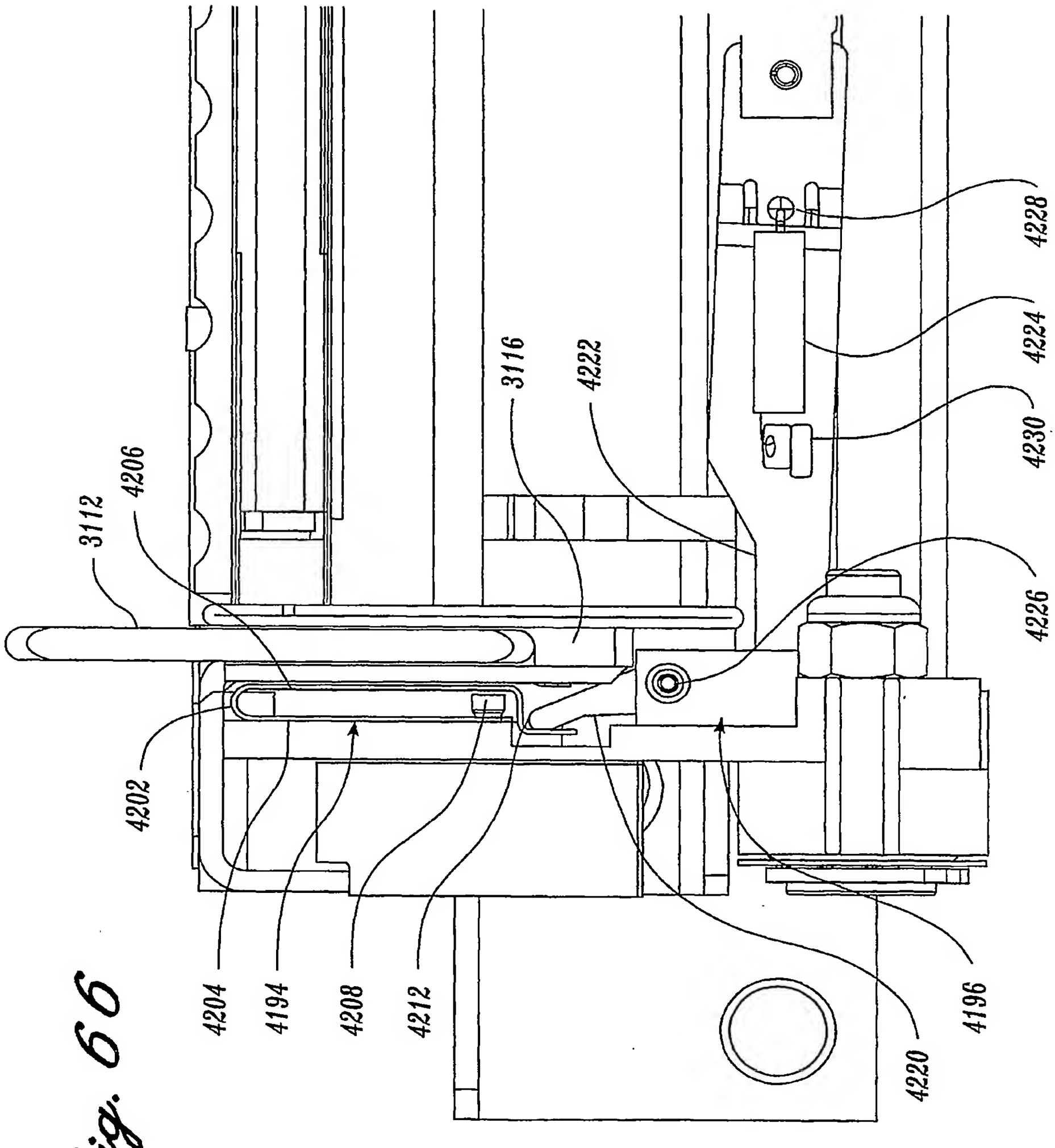

3112
4206
4202
4204
4194
4208
4212
3116
4222
4228
4224
4230
4226
4220
4196

Fig. 66

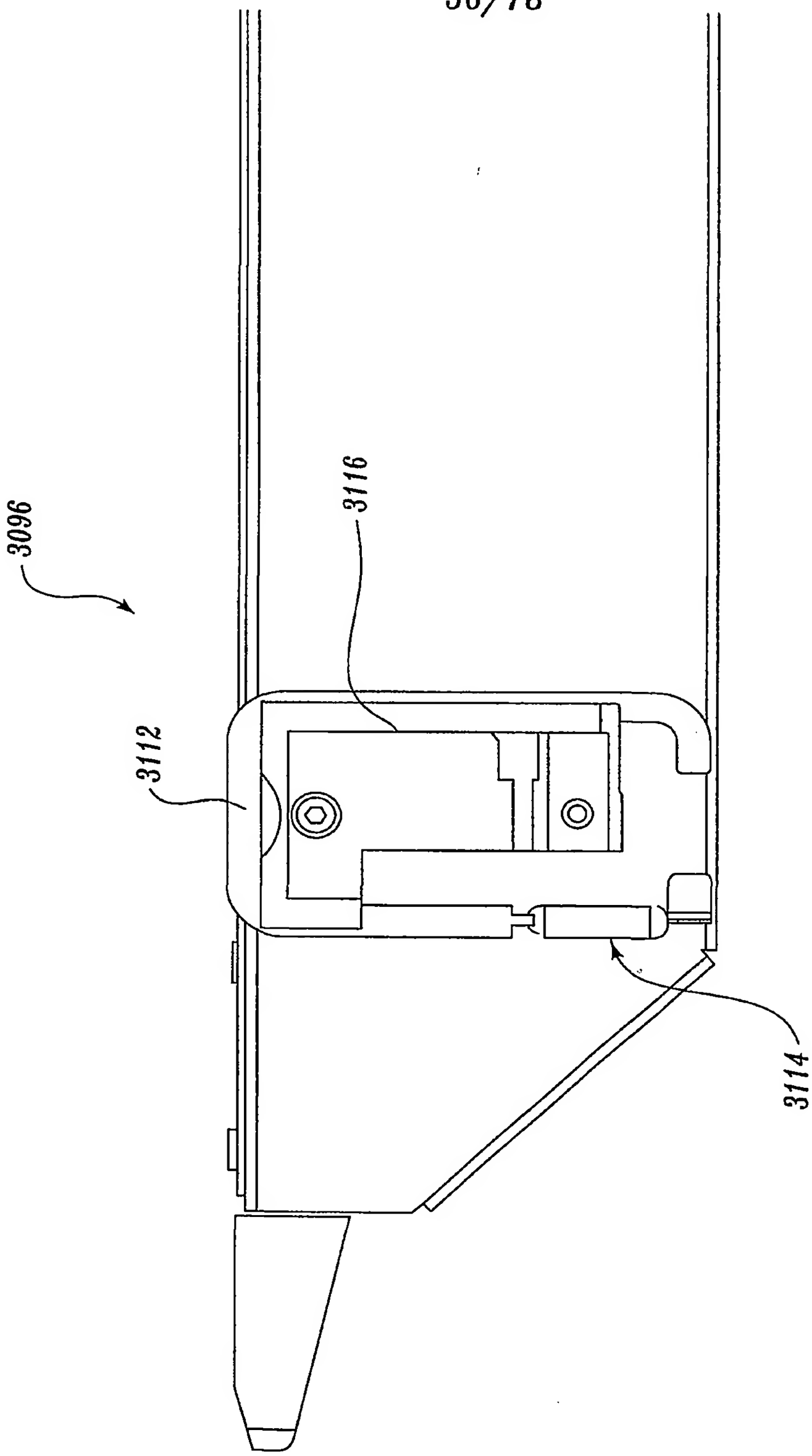


Fig. 67

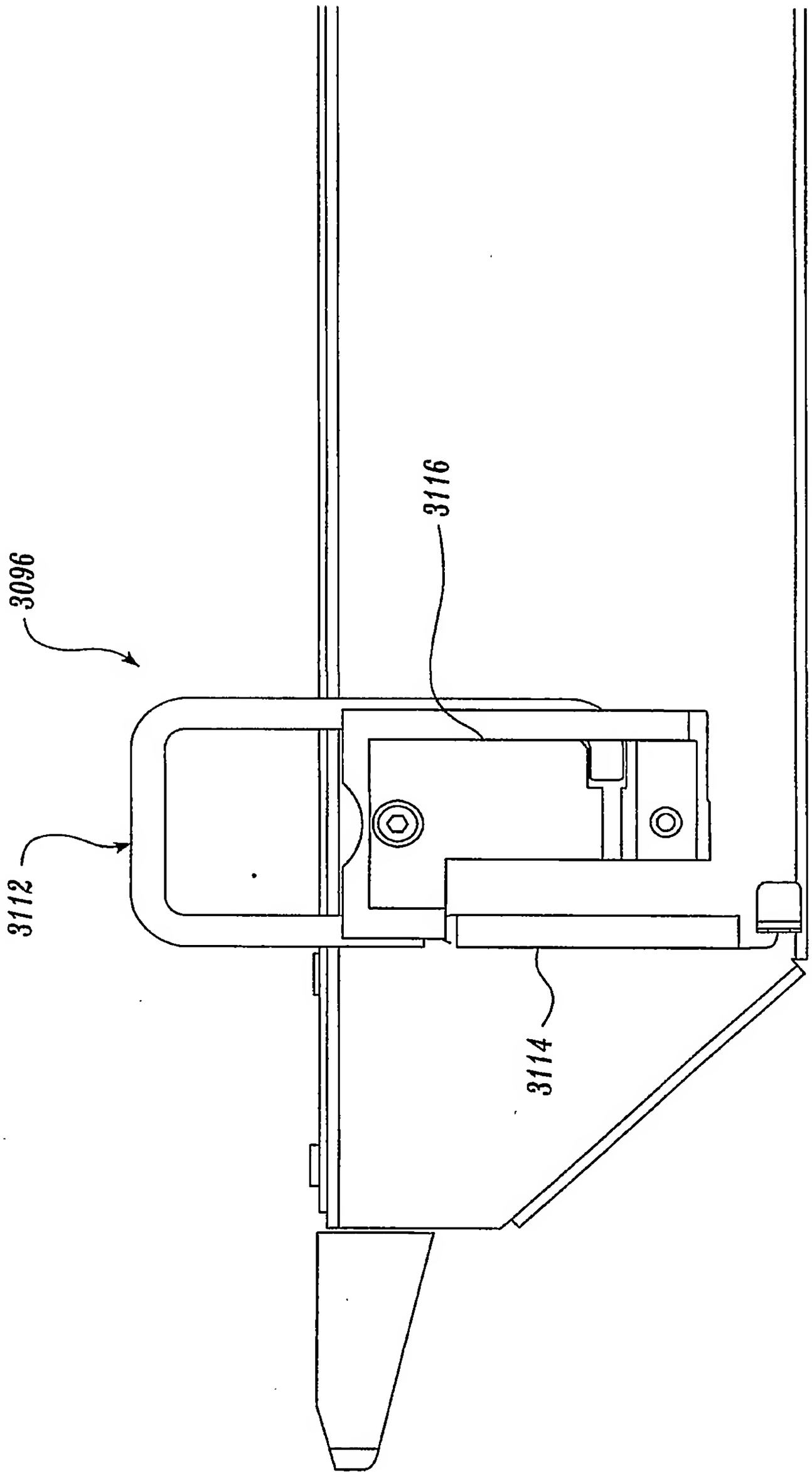
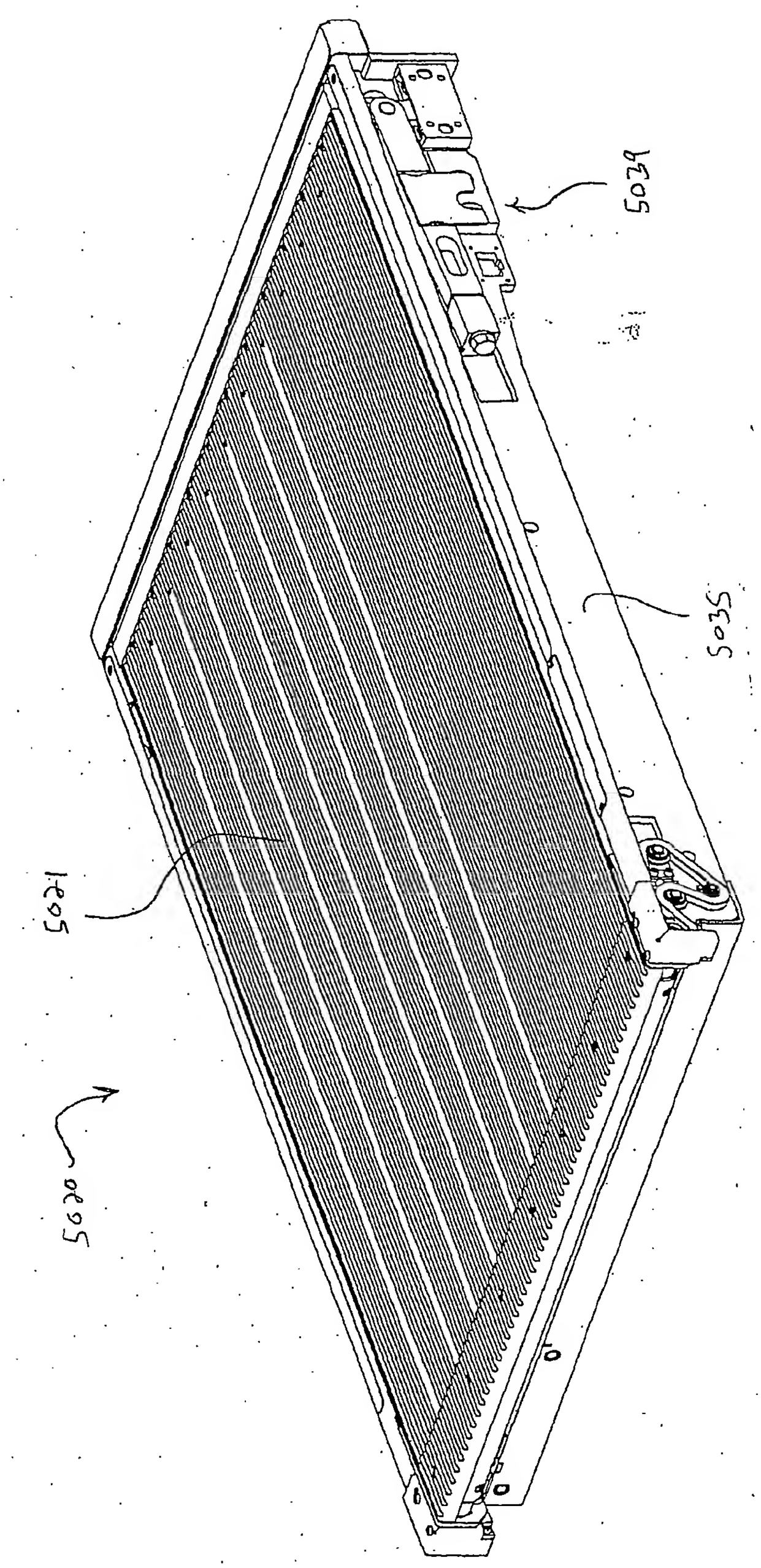


Fig. 68


5039
5035
5021
5020

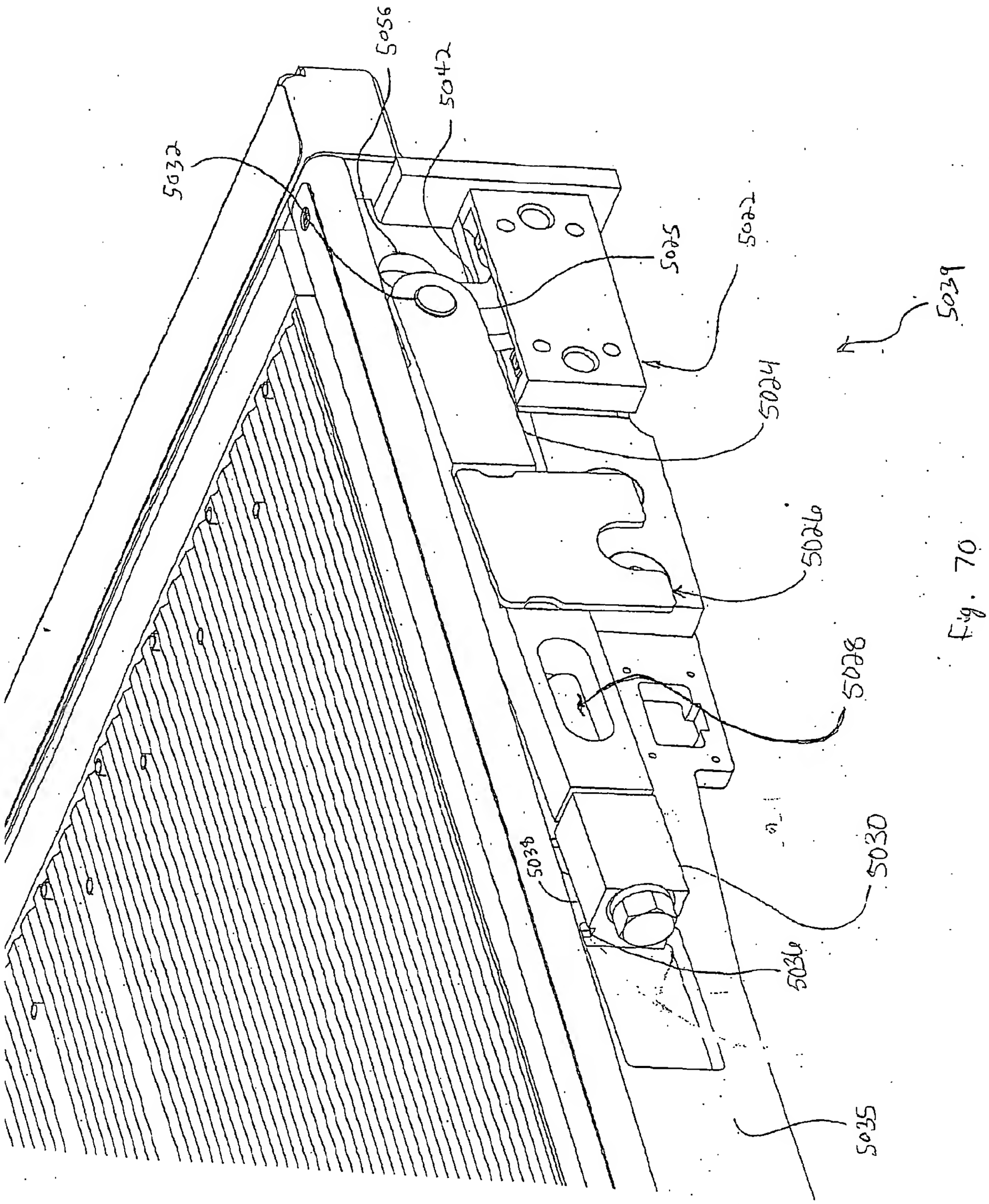

5056
5042
5032
5025
5022
5029
5024
5026
5028
5034
5030
5036
5035

Fig. 70

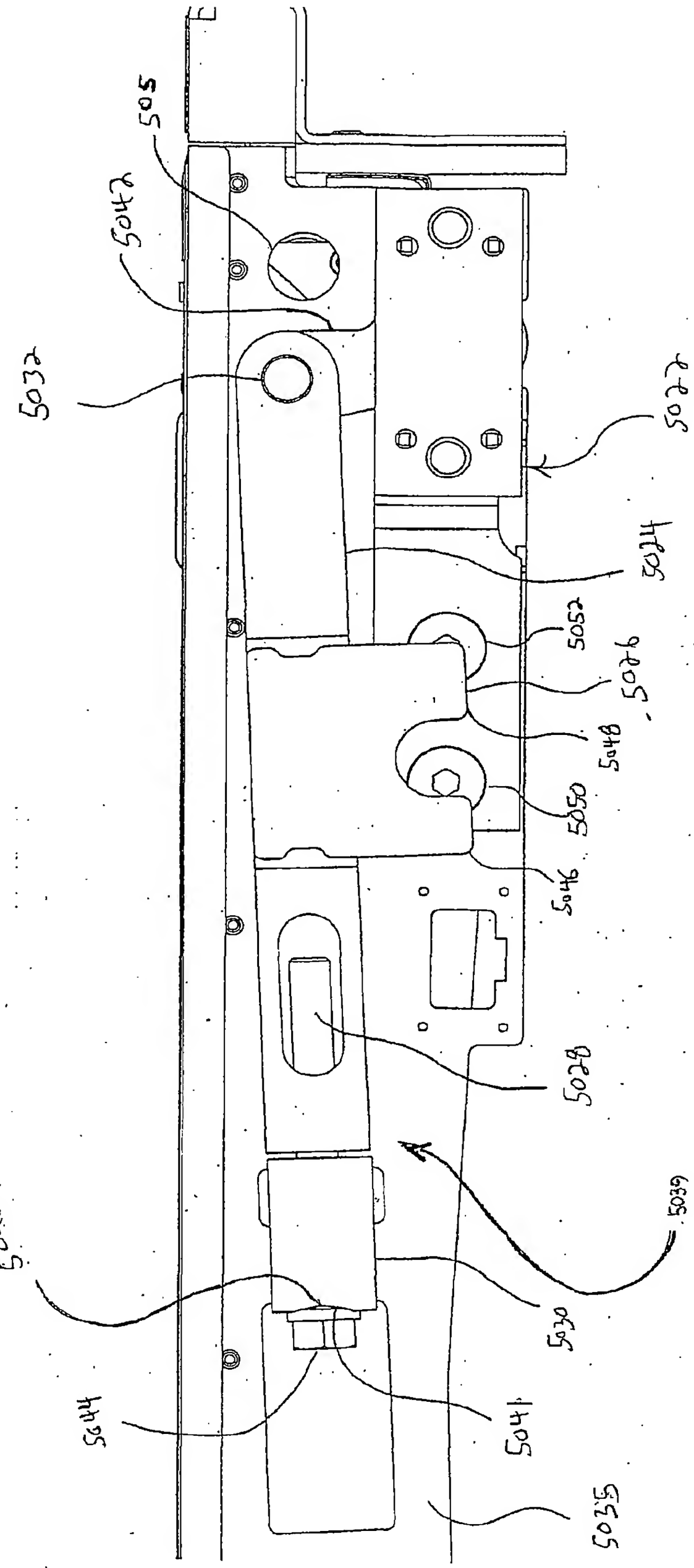

5042
505
5032
5028
5044
5052
5026
5048
5050
5046
5040
5044
5041
5030
5039
5035

Fig. 71

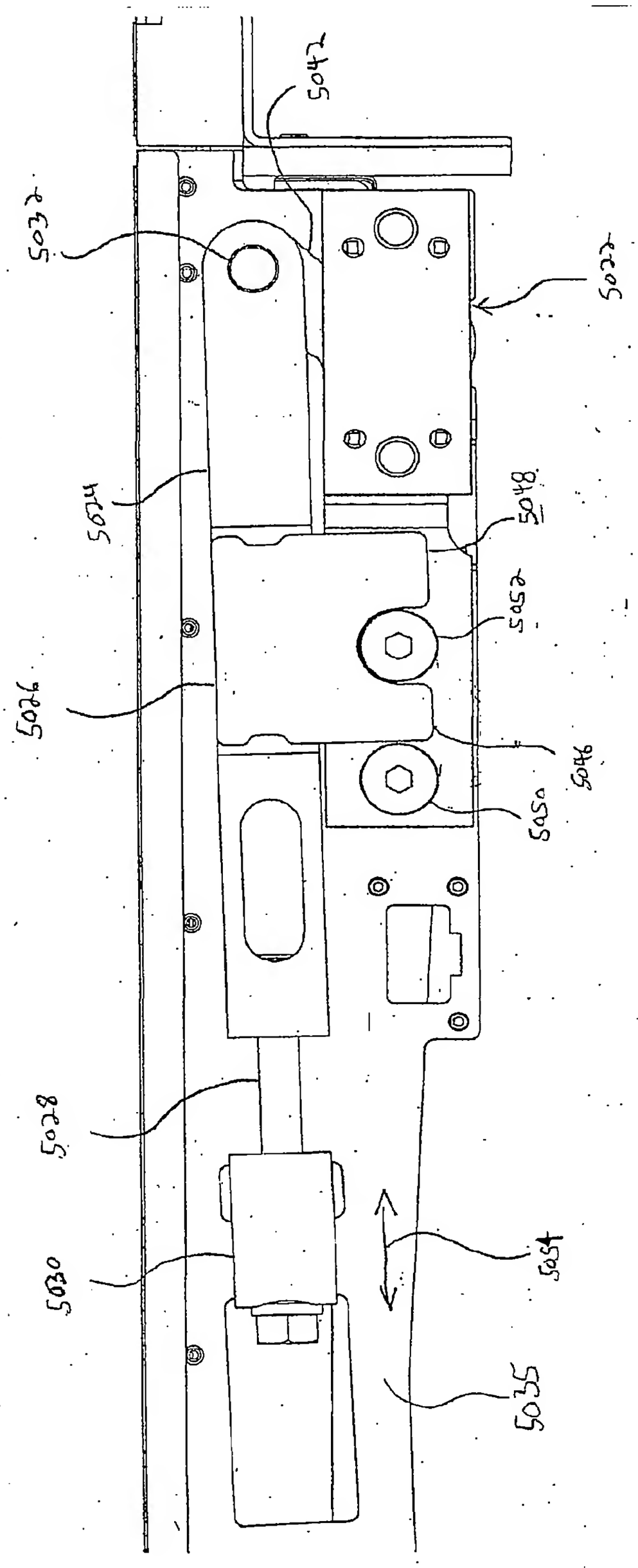


Fig 72

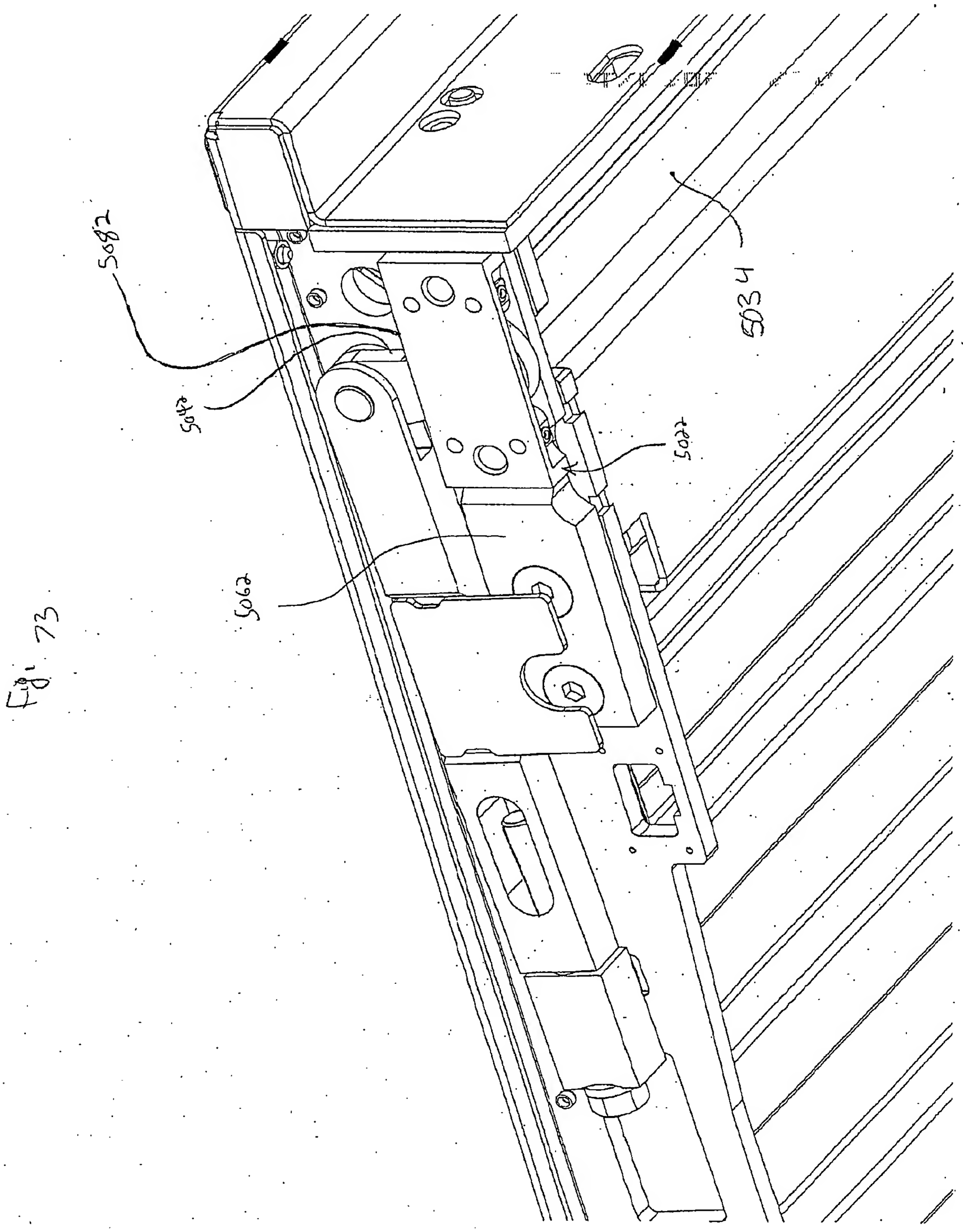


Fig. 73

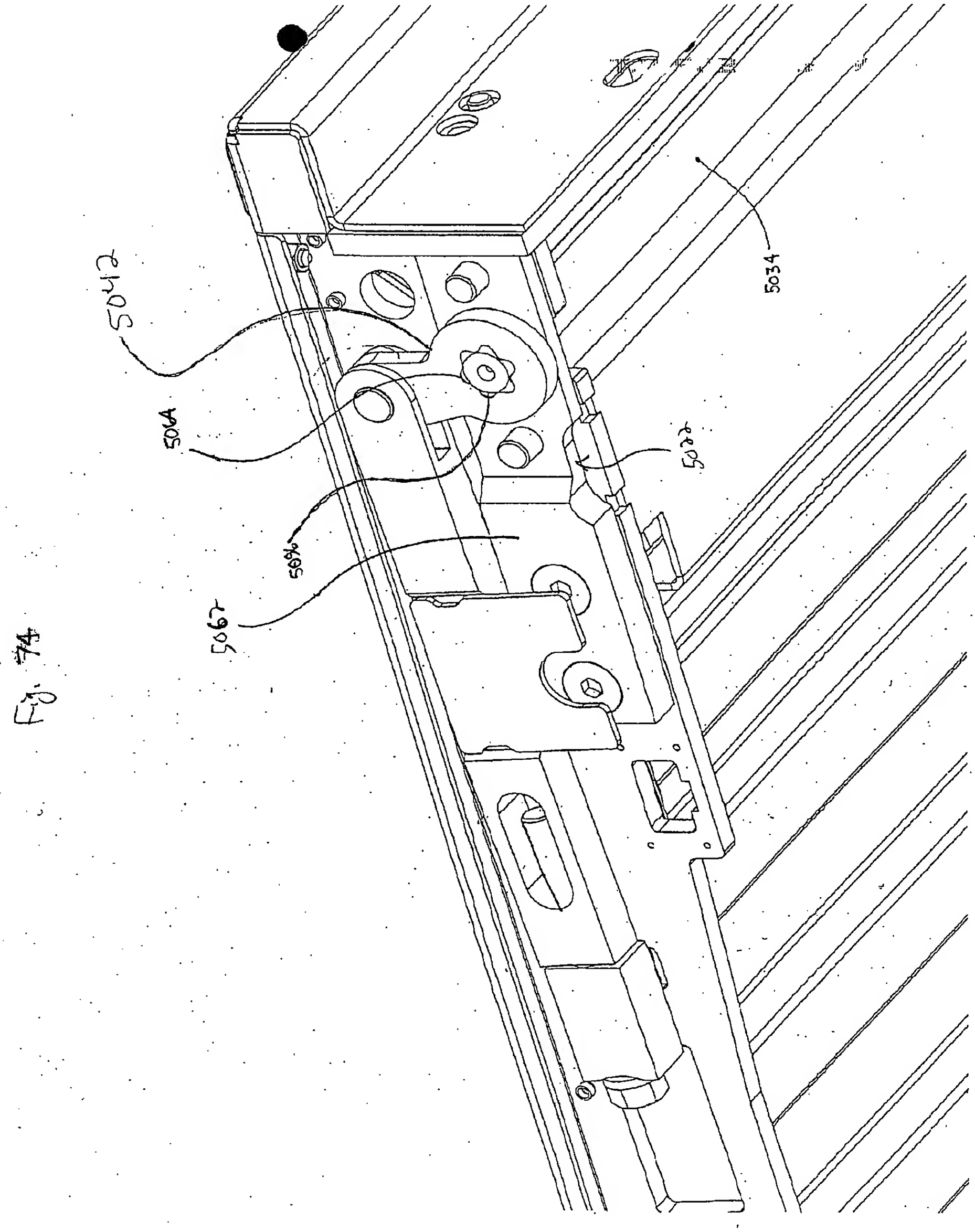


Fig. 74

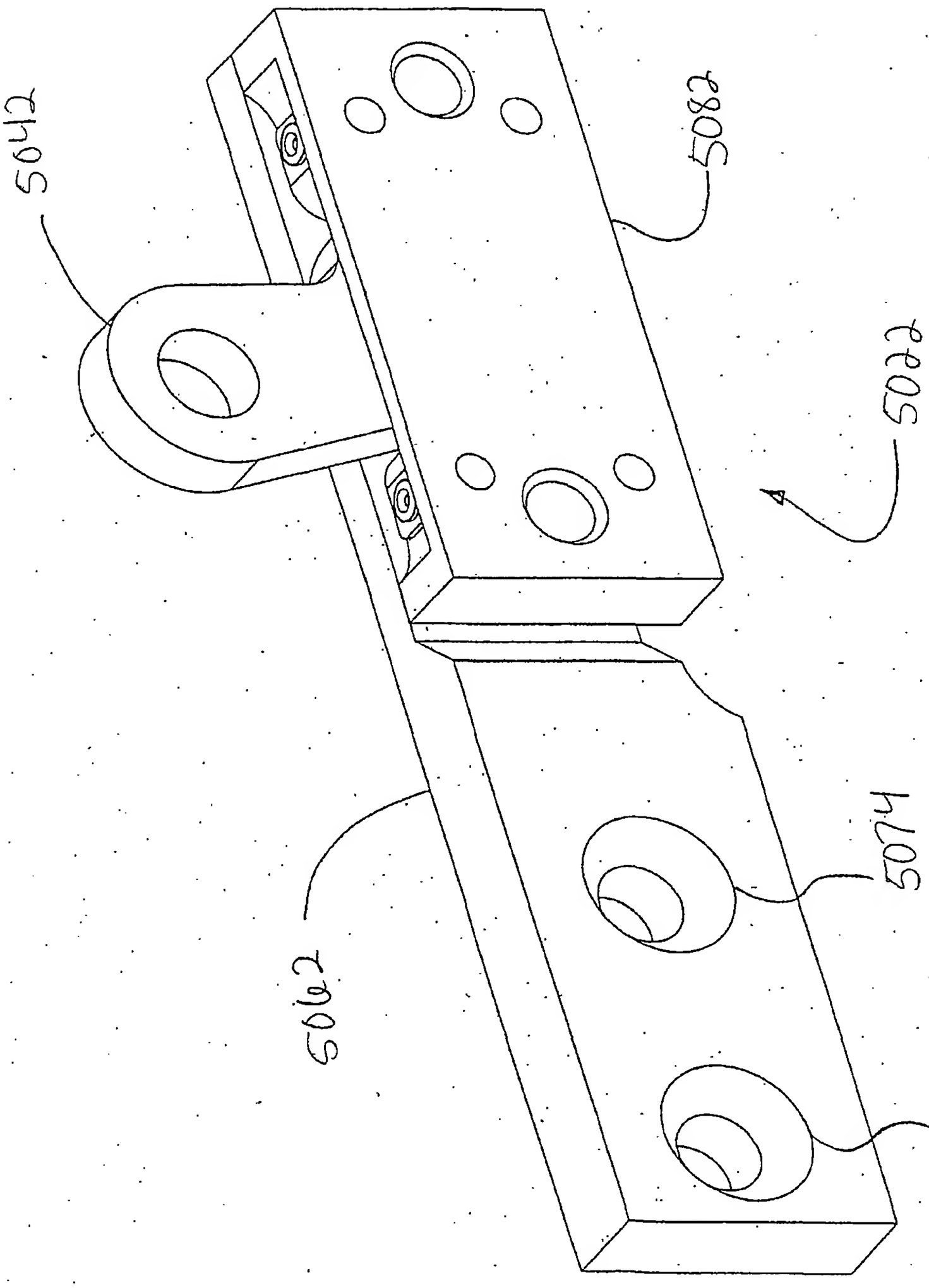


Fig. 15

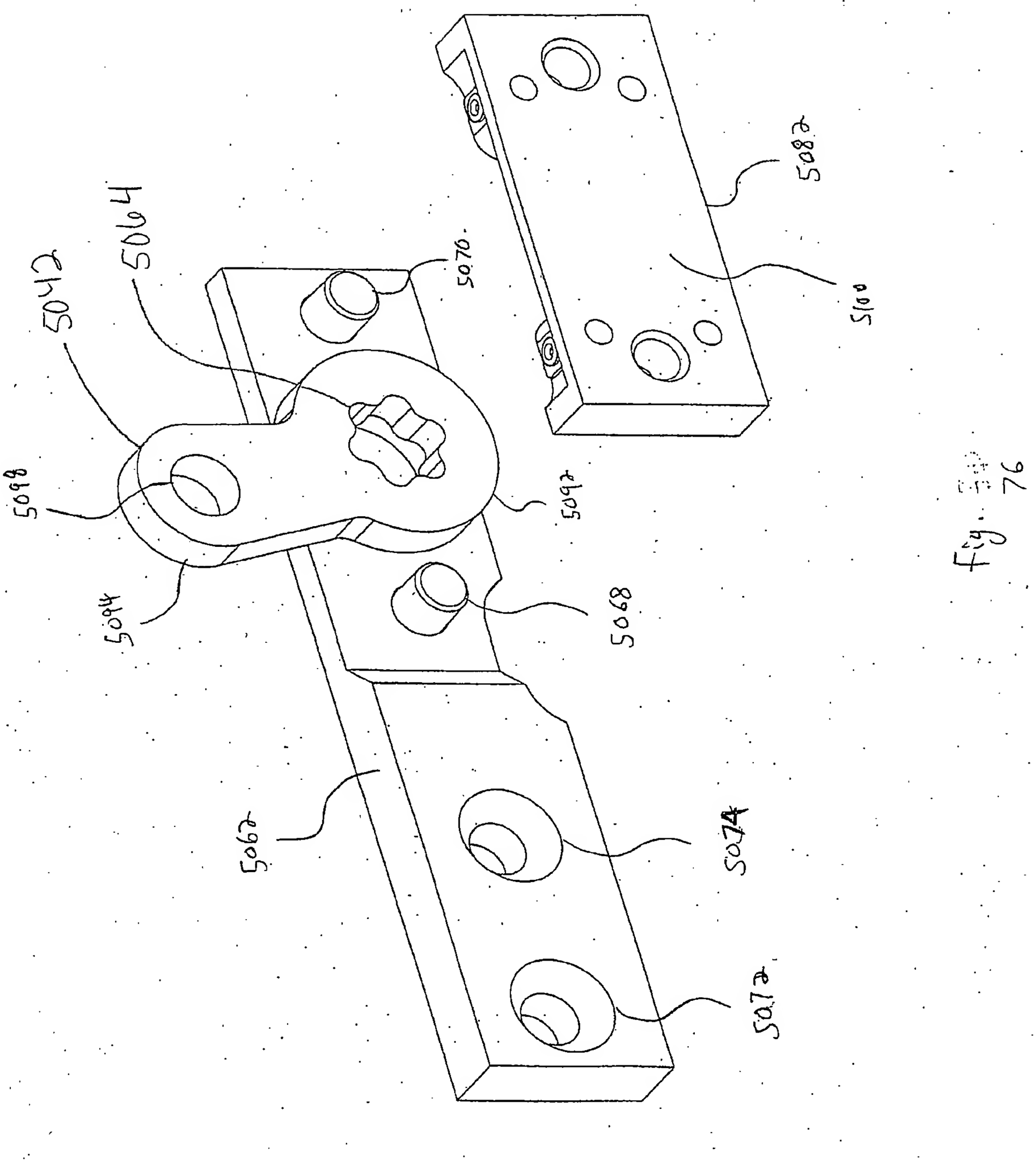


Fig. 76

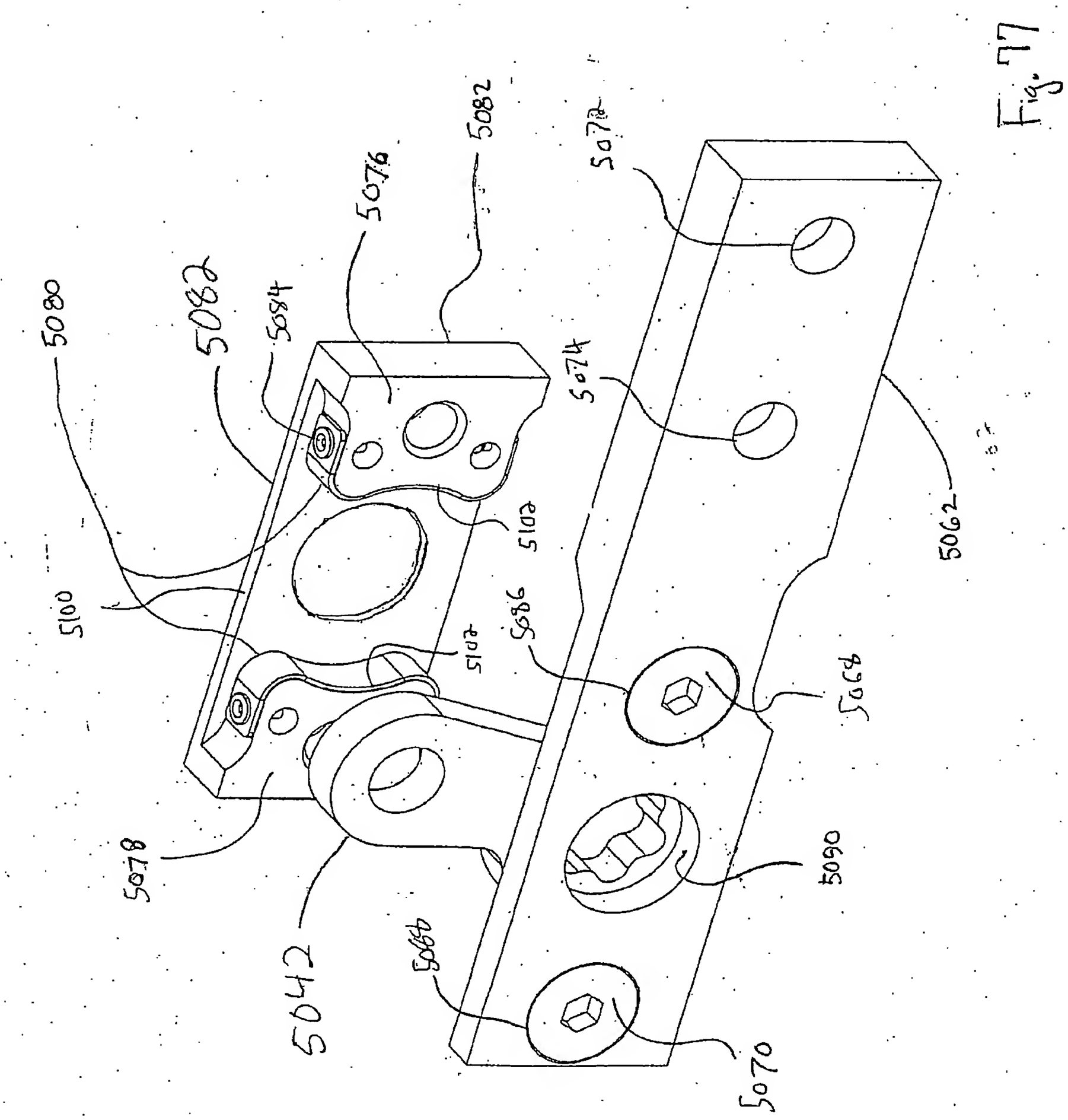

5080
5082
5084
5076
5074
5100
5102
5086
5078
5042
5062
5064
5090
5070

Fig. 77

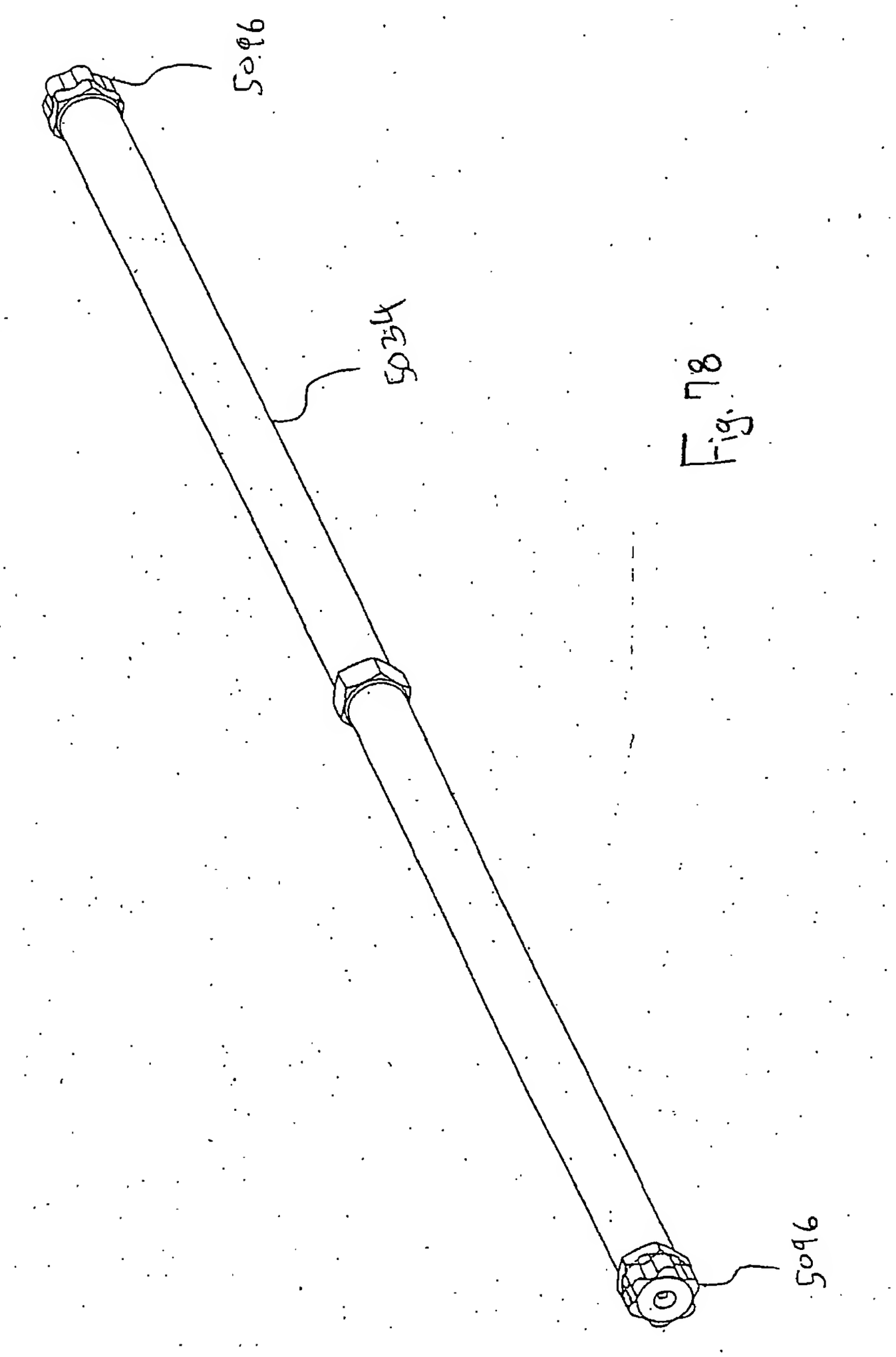


Fig. 78

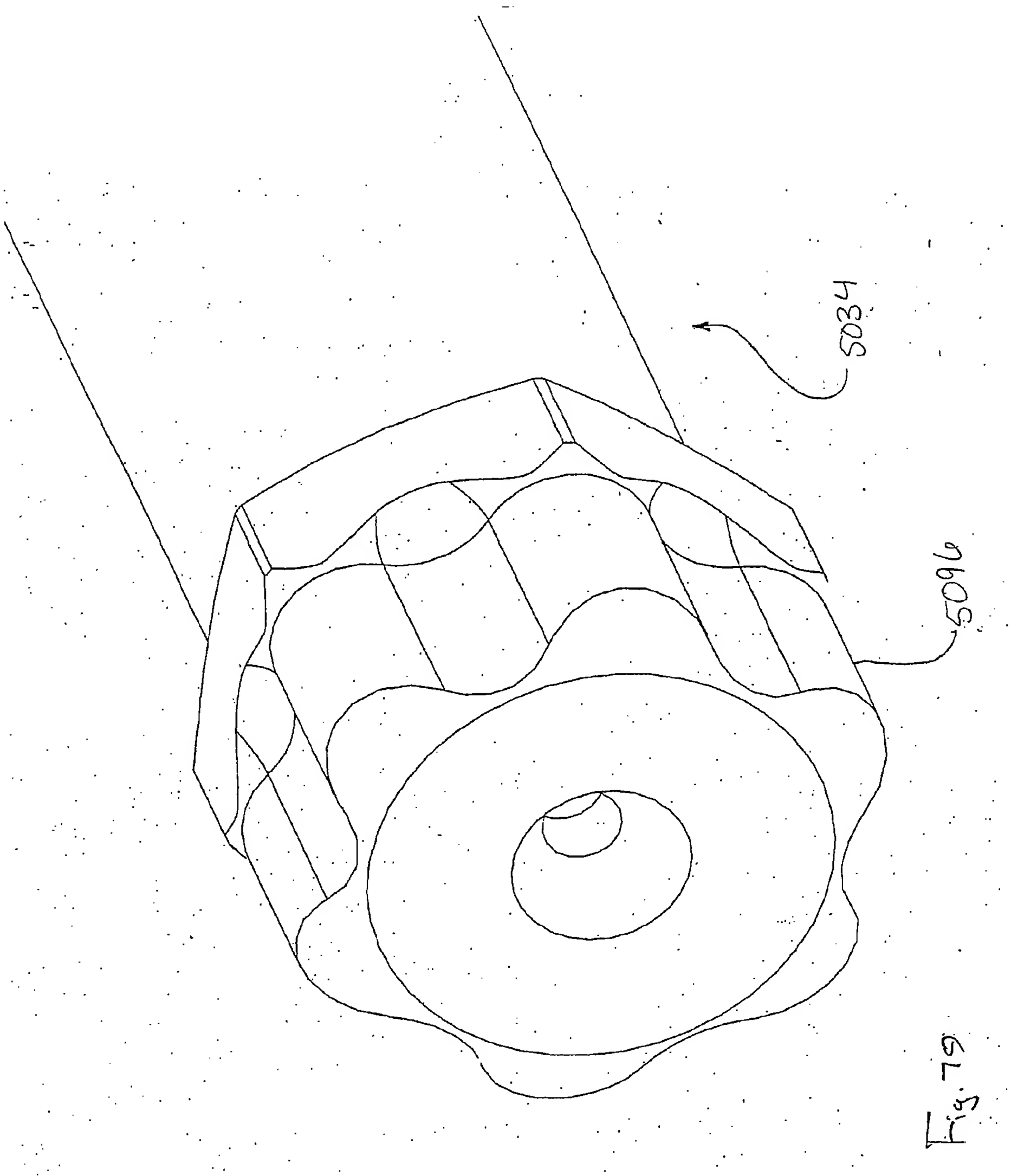


Fig. 67

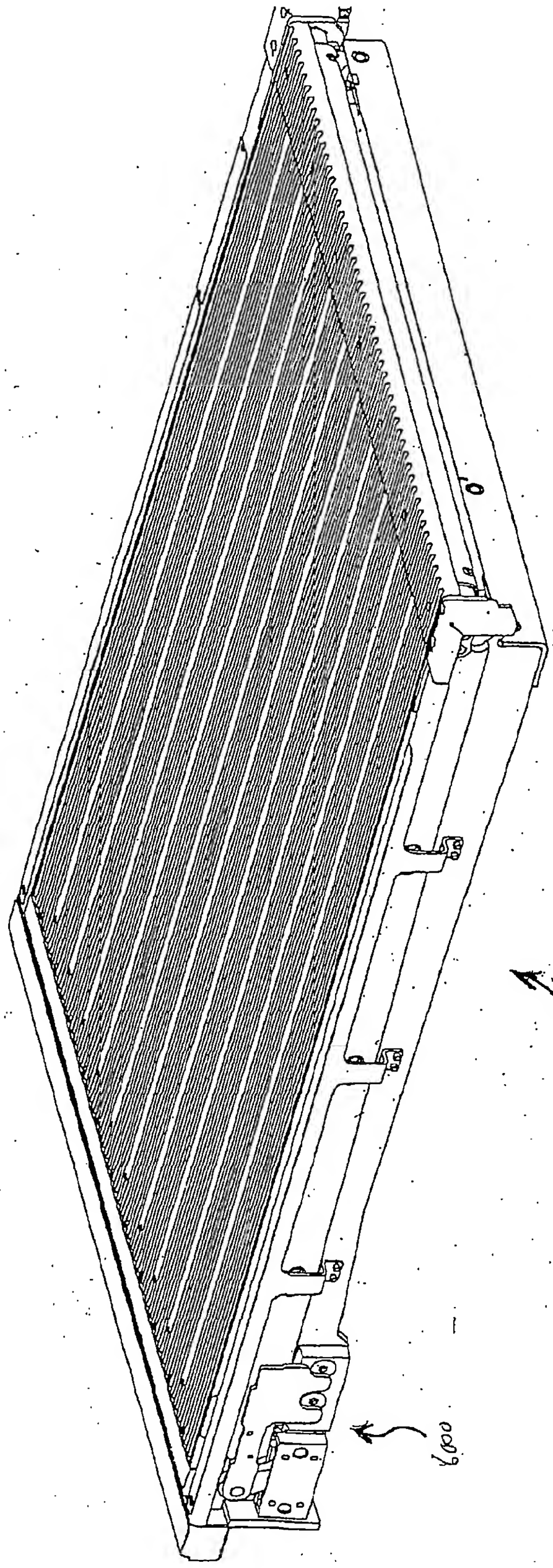


Fig. 80

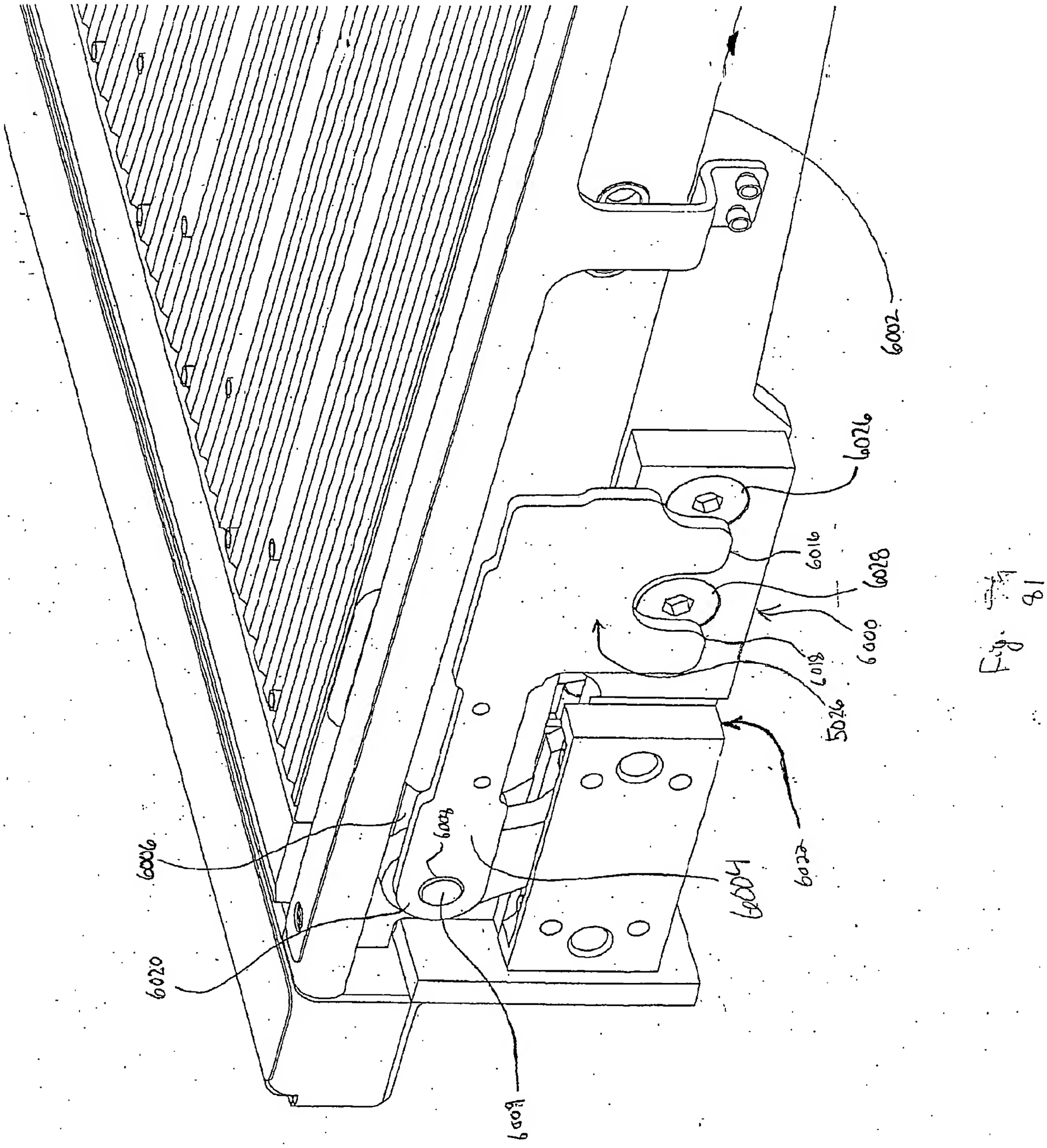


Fig. 81

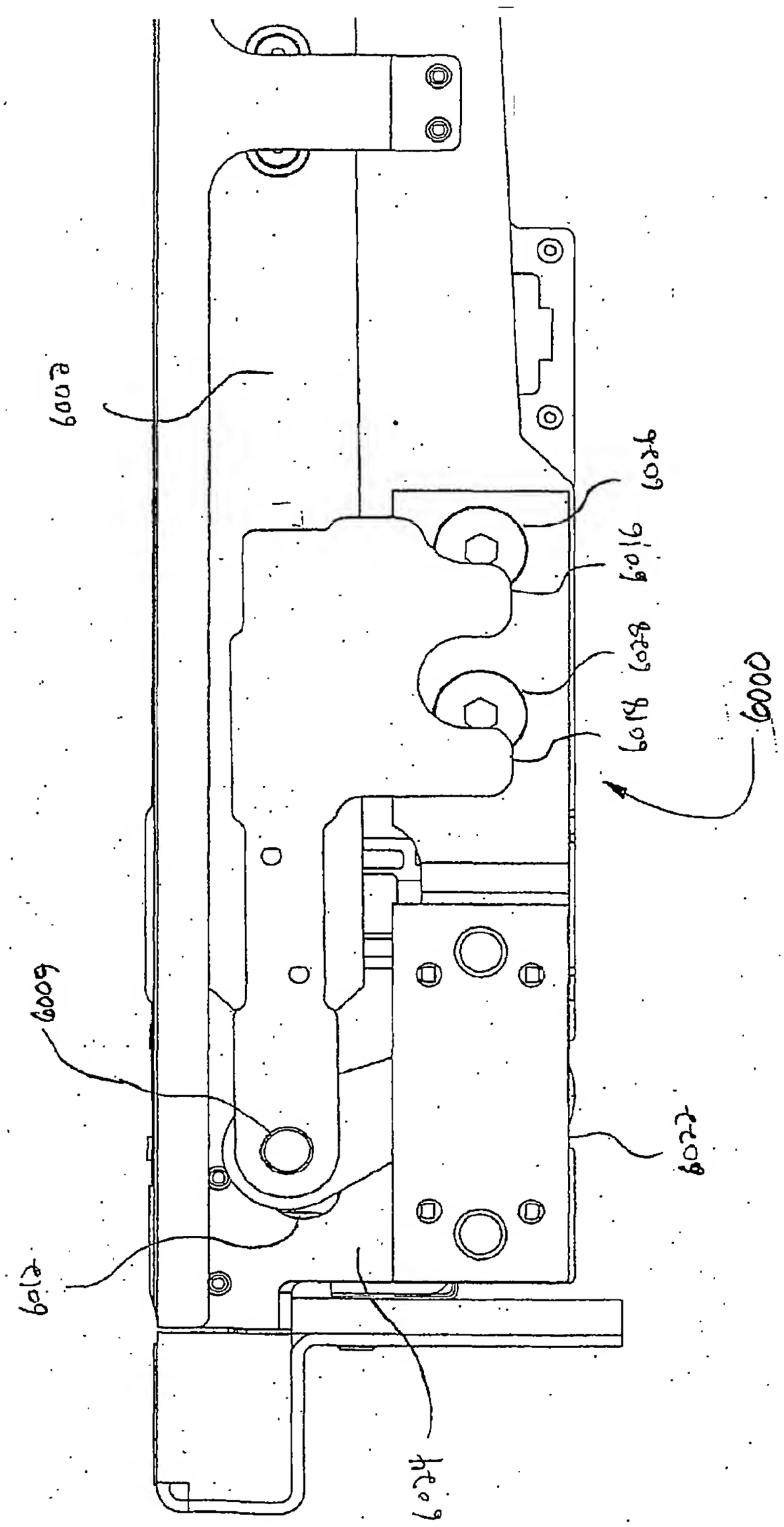


Fig. 78

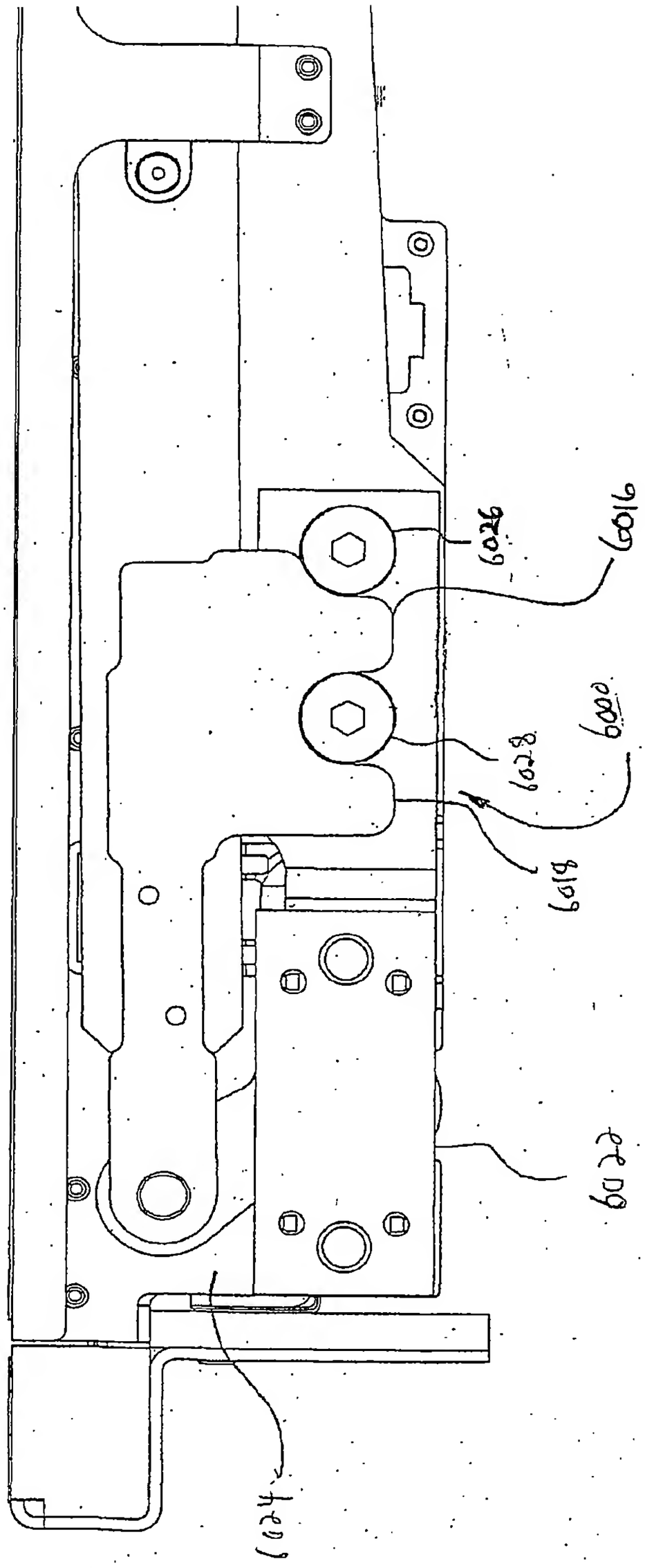
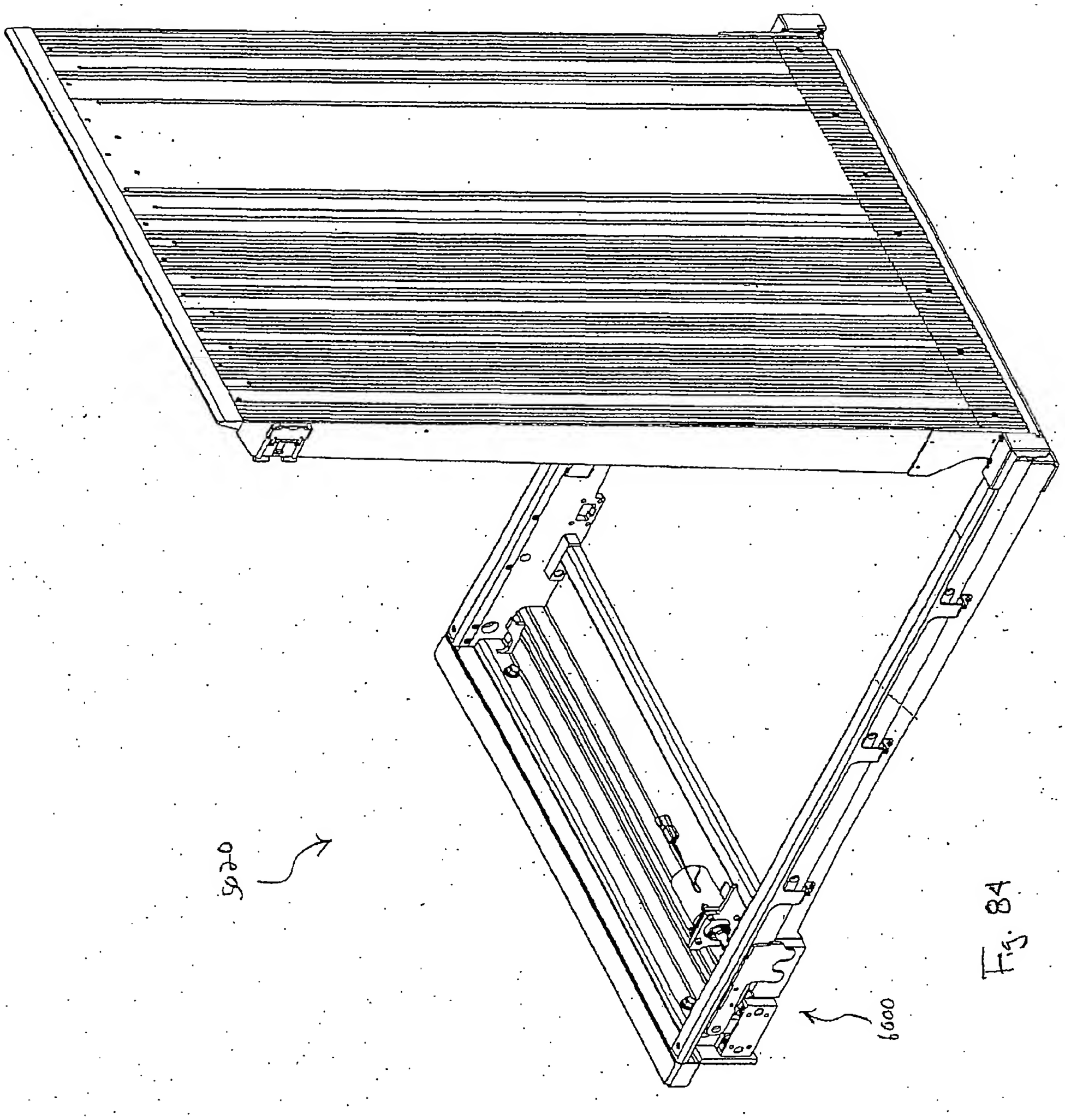


Fig. 83


920
600
84
H5

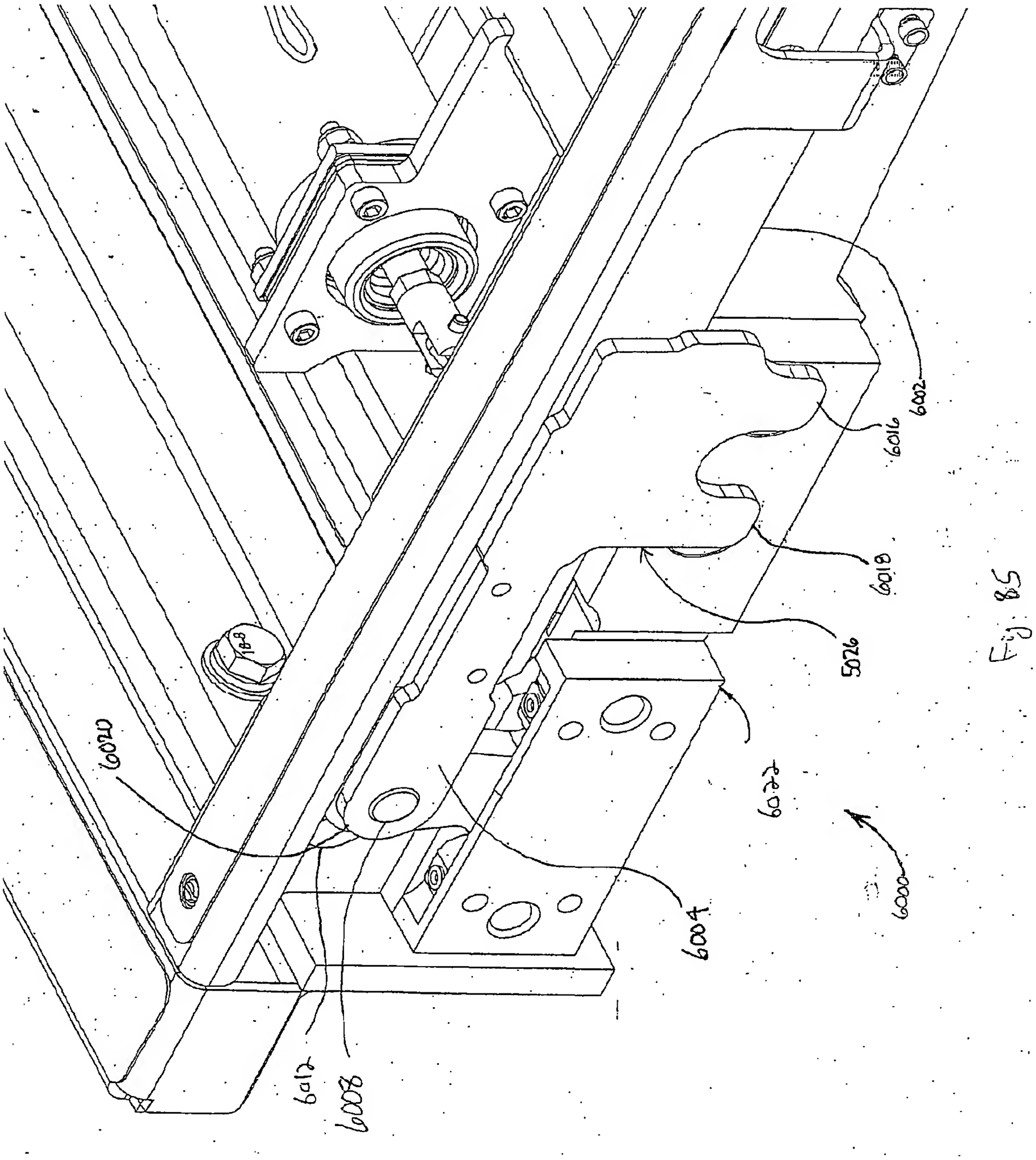


Fig. 85

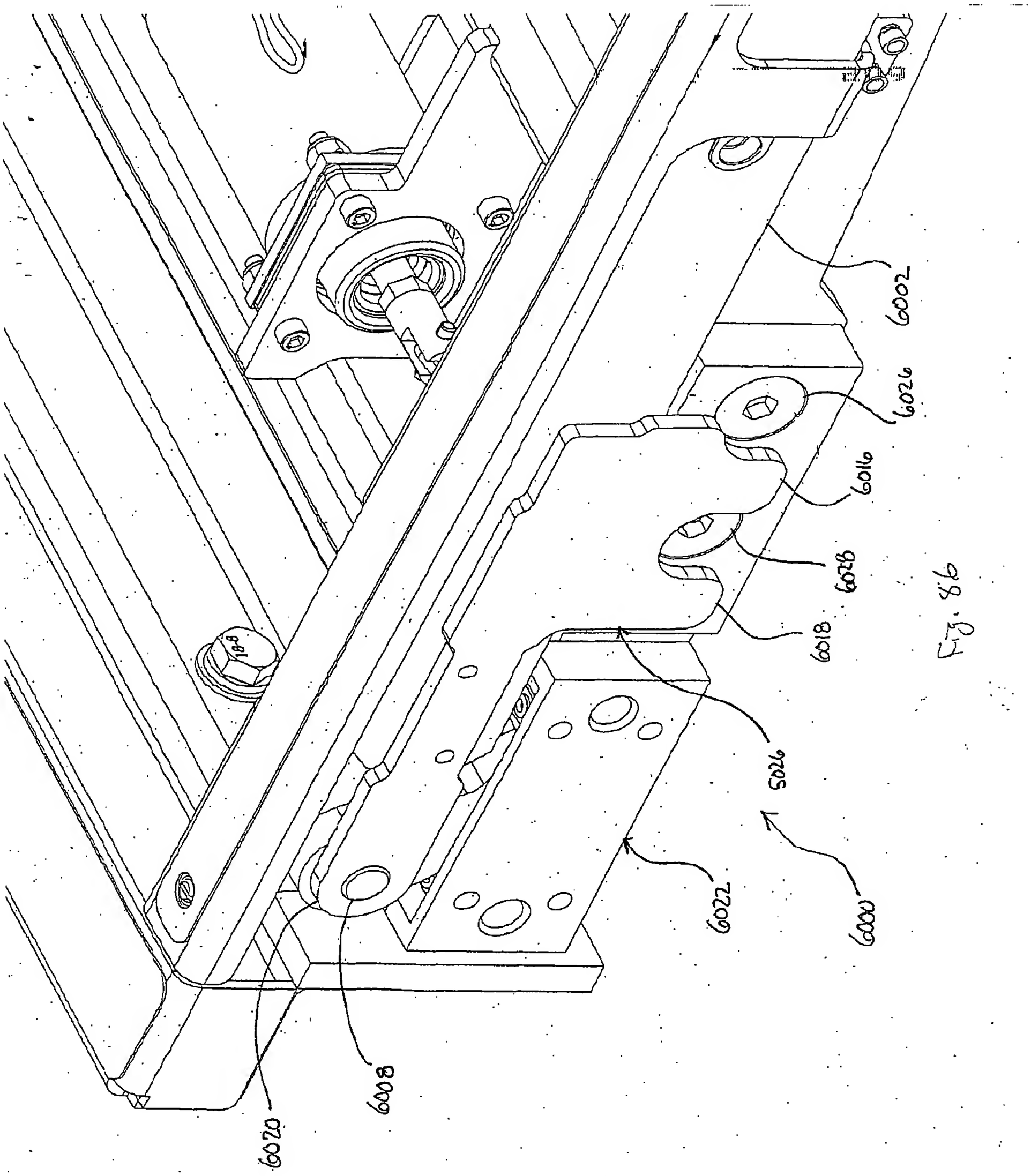


FIG. 86

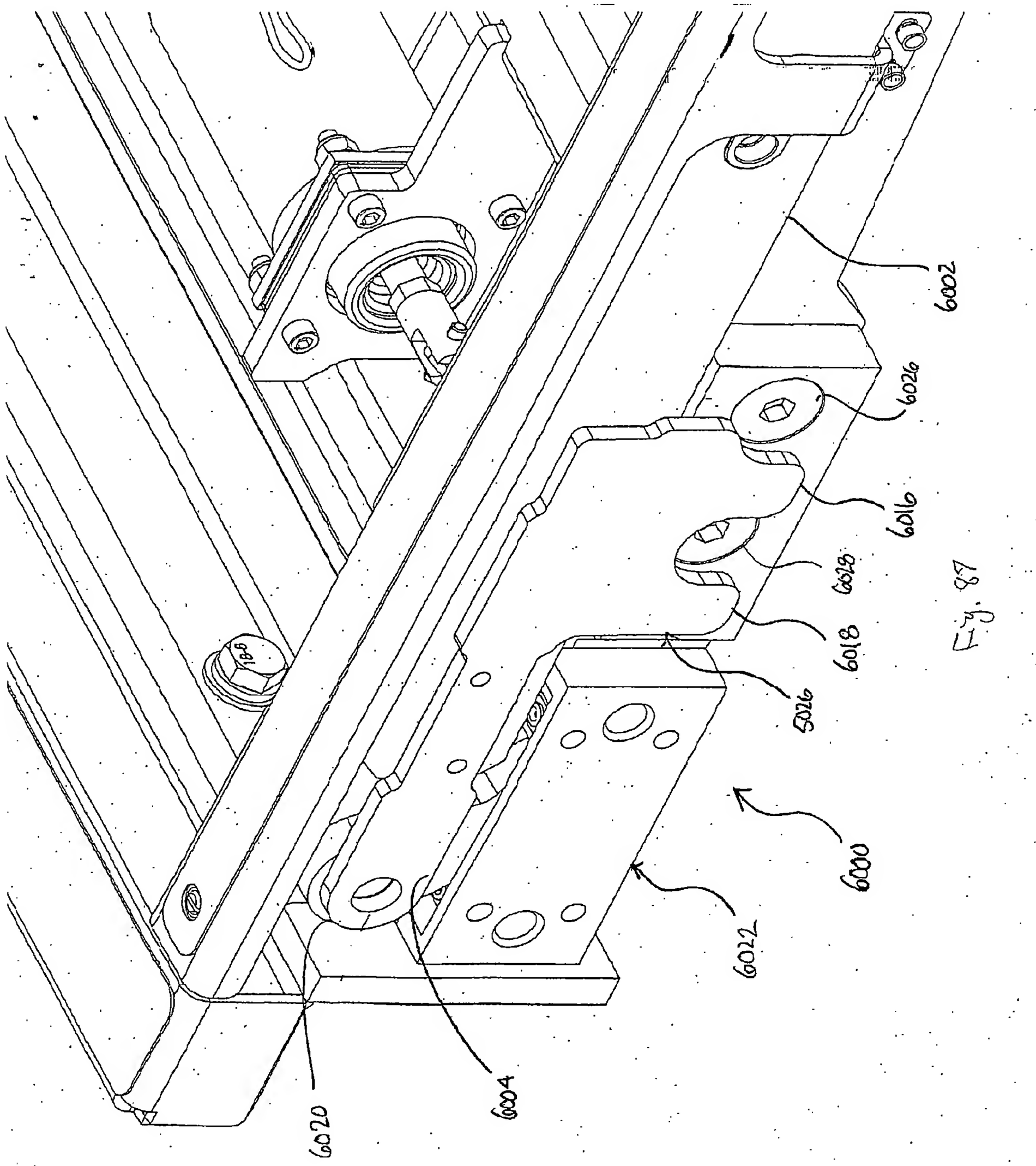
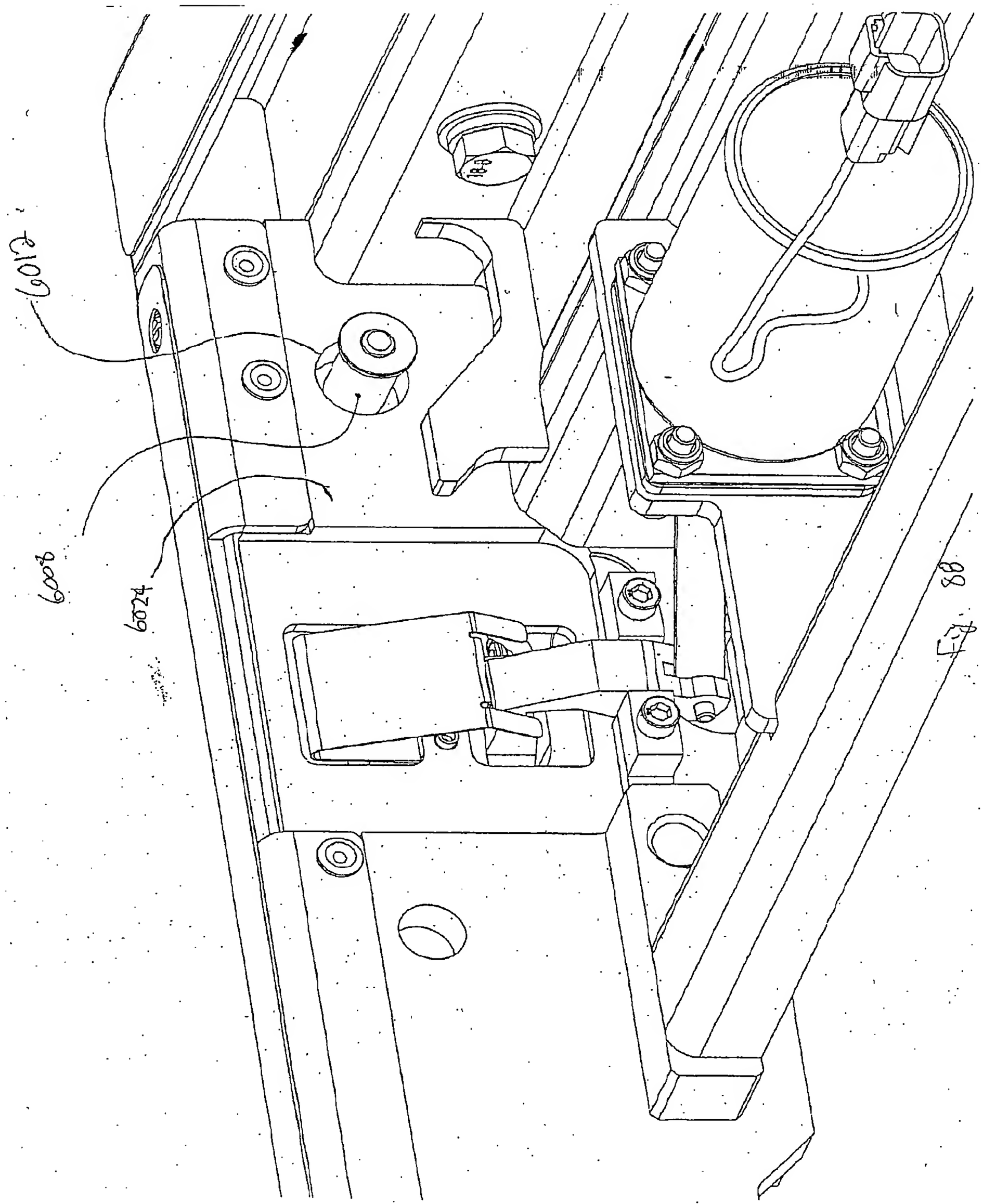


Fig. 87


6012
6008
6024
88

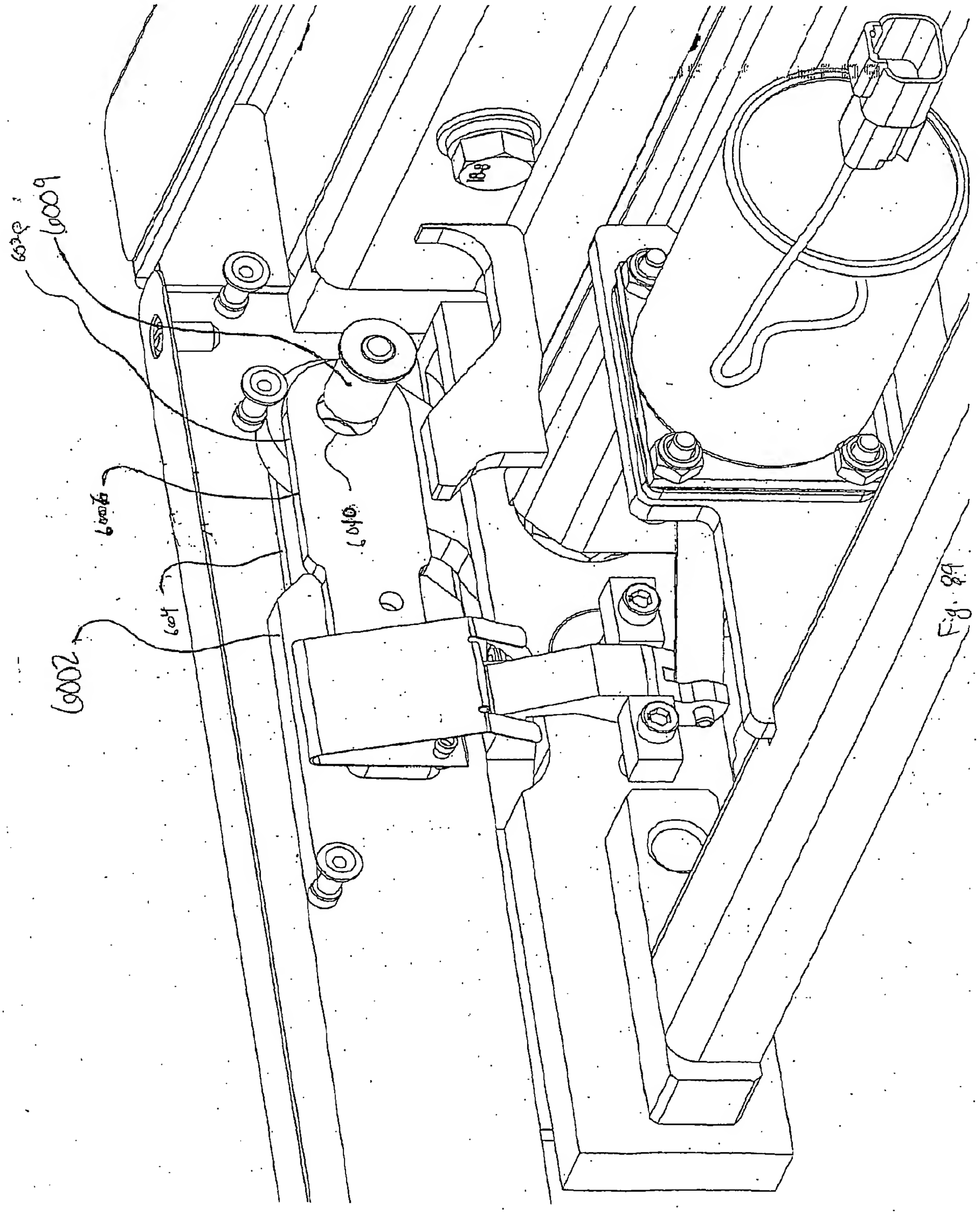


Fig. 8A

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 October 2002 (24.10.2002)

PCT

(10) International Publication Number
WO 02/083455 A3

(51) International Patent Classification[7]: A61G 3/08

(21) International Application Number: PCT/US02/12209

(22) International Filing Date: 17 April 2002 (17.04.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/284,543 17 April 2001 (17.04.2001) US

(71) Applicant *(for all designated States except US)*: **LIFT-U, DIVISION OF HOGAN MGF., INC.** [US/US]; 1520 First Street, Escalon, CA 95320 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **COHN, Alan** [US/US]; 17256 North Tretheway Road, Lockeford, CA 95237 (US).

(74) Agent: **DENKENBERGER, John, D.**; Christensen O'Connor Johnson & Kindness PLLC, Suite 2800, 1420 Fifth Avenue, Seattle, WA 98101 (US).

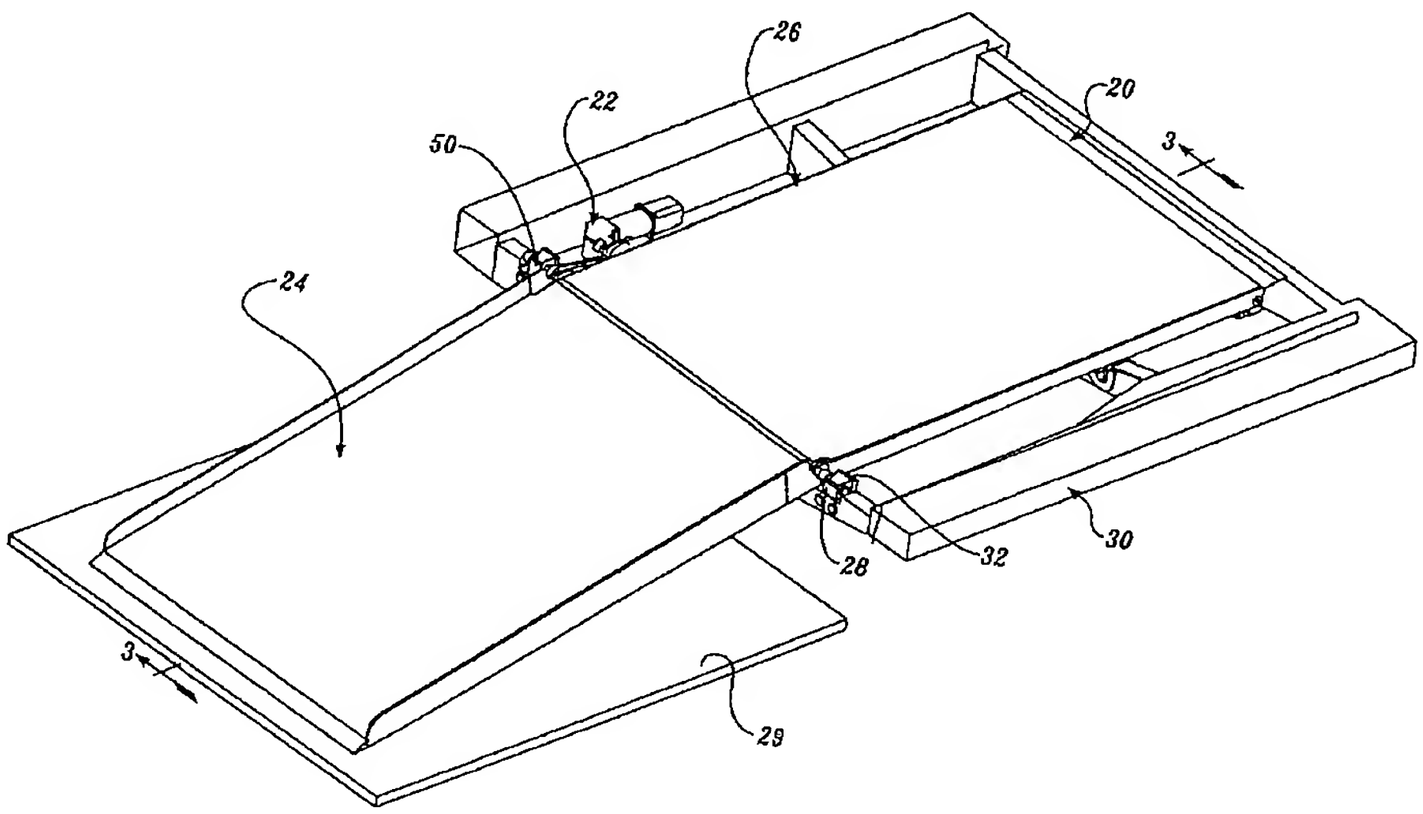
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

[Continued on next page]

(54) Title: VEHICLE FOLD-OUT RAMP



(57) Abstract: A ramp assembly (20) having a frame attachable to a vehicle having a floor is disclosed. The ramp assembly further includes a platform coupled to a portion of the frame, a ramp (24) having a weight, and a reciprocating mechanism disposed between the ramp and the platform coupled to a portion of the frame. The ramp assembly (20) also includes a reciprocating mechanism disposed between the ramp (24) and the platform for reciprocating the ramp (24) between a deployed position and a stowed position in response to a load. The reciprocating mechanism (28) counterbalancing the weight of the ramp during actuation of the ramp (24) between the deployed and stowed positions to reduce the load required to reciprocate the ramp (24) between the deployed and stowed positions.

WO 02/083455 A3

(88) Date of publication of the international search report:
10 April 2003

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/12209

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : A61G 3/08
US CL : 414/546, 549, 921
According to International Patent Classification (IPC) c. to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 414/546, 549, 921

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
West

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,797,042 A (MCFARLAND) 10 JANUARY 1989, SEE ENTIRE DOCUMENT.	1-39
Y	US 4,627,784 A (COLLINS) 09 DECEMBER 1986, SEE ENTIRE DOCUMENT.	1-39
Y	US 5,145,310 A (CALZONE) 08 SEPTEMBER 1992, SEE ENTIRE DOCUMENT.	1-39
A	US 5,040,936 A (RHEA) 20 AUGUST 1991, SEE ENTIRE DOCUMENT.	1-39
A	US 4,836,736 A (NEAGU) 06 JUNE 1989, SEE ENTIRE DOCUMENT.	1-39

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
06 August 2002 (06.08.2002)

Date of mailing of the international search report
30 JAN 2003

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. (703)305-3230

Authorized officer
Steven A. Bratlie
Telephone No. (703) 308-2669

Form PCT/ISA/210 (second sheet) (July 1998)